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VOL. CXXXVI.—No. 3539] LONDON: FRIDAY EVENING, OCTOBER 26, 1923 [PRICE ONE SHILLING ST INLAND POST 1s. 3d.

The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES:—
GALVANISED CORRUGATED MILD STEEL SHEETS.
Tenders due on the 15th November, 1923.
Tender forms obtainable from above. 3915

Assistant Engineer REQUIRED for the GOVERNMENT of the GOLD COAST, for service on the Takoradi Harbour Works, for one tour of 12 to 15 months, with possible extension. Salary £700 a year. Free quarters and passages and liberal leave in England on full salary. Candidates, age 28 to 40, should be capable civil engineers with good experience in the design and construction of railway and harbour works, and be good draughtsmen and expert surveyors. Graduate in Engineering Science preferred.—Apply by letter, stating age, whether married or single, qualifications, and experience, to Messrs. STEWART and McDONNELL, 6/7, Cowley-street, London, S.W. 1. 3906

Assistant Town Engineer REQUIRED by the GOVERNMENT of the GOLD COAST, for service with the Coomassie Public Health Board, for a tour of 12 to 18 months' service, with possible extension. Salary £480 for the first three years of service and then £540, rising to £720 a year by annual increments of £30, and thence to £920 by annual increments of £40. Outfit allowance of £60 on first appointment. Free single quarters or an allowance in lieu. Free passages and liberal leave in England on full salary. Candidates, aged 25 to 35, preferably single, must be fully qualified civil engineers with experience in town-planning, construction of town roads, surveying, and the preparation and execution of drainage schemes. They should have served in the Engineering Department of a municipality and should be able to ride a motor bicycle.
Apply at once in writing, stating age and giving brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/12,317. 3939

Civil Service Commission. FORTHCOMING EXAMINATION: PROBATIONARY INSPECTORS in the Engineer-in-Chief's Department of the General Post Office (17-23, with extension for service in H.M. Forces during the war), 14th NOVEMBER.
The date specified is the latest on which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, Burlington-gardens, London W.1. 3857

The Institution of Mechanical ENGINEERS.
THOMAS HAWKSLEY LECTURE, 1923.
SIR WESTCOTT S. ABELL, K.B.E., M.Eng., will deliver the above Lecture on "THE MECHANICAL PROBLEMS OF THE SAFETY OF LIFE AT SEA," at the Institution, Storey's-gate, Westminster, on Friday, 2nd November, 1923, at 6 p.m.
Visitors are invited.
The Lecture will be repeated in Liverpool, 8th November; Leeds, 9th November; and Glasgow, 7th December. 3917

CONTENTS OF THE FIRST NUMBER OF THE
Journal of Scientific Instruments.
Published on October 15th, 1923.
A Monthly Publication produced by the INSTITUTE OF PHYSICS with the Co-operation of the NATIONAL PHYSICAL LABORATORY.
Price: Single Copies, 2s. 6d.
Annual Subscription, 30s. including postage.
CONTENTS.
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TWO NEW METHODS of MEASURING the INTERNAL DIAMETERS of TRANSPARENT TUBES. By JOHN S. ANDERSON, M.A., D.Sc., Ph.D., and GUY BARR, B.A., D.Sc.
On an IMPROVED TEMPERATURE CONTROL for the PULFRICH REFRACTOMETER. By T. M. LOWRY, D.Sc., F.R.S., and E. G. PARKER, B.Sc.
A NEW RELAY and its APPLICATION to SUSTAINING PENDULUM VIBRATIONS. By H. A. THOMAS, M.Sc.
A GENERAL-PURPOSE RECORDING DRUM. By C. V. BOYS, F.R.S.
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A NEW RECORDING KATA-THERMOMETER. By E. H. J. SCHUSTER, D.Sc.
MISCELLANEA.
REVIEWS.
Editorial communications should be addressed to Dr. J. S. ANDERSON, National Physical Laboratory, Teddington.
Business communications to the SECRETARY, The Institute of Physics, 10, Essex-street, London, W.C. 2. 3826

The Scottish Gympie Gold MINES, LIMITED (in Liquidation).
TENDERS are INVITED for the PURCHASE of the whole or any portion of the TENANT'S RIGHTS in MINING LEASES, extending to 75 acres or thereby, along with the valuable up-to-date PLANT and MACHINERY, situated on the Company's Mine at Monkland, near Gympie, Queensland.
There are three shafts with the necessary equipment and suitable buildings. There is also a large quantity of tailings, believed to contain gold sufficient to pay for treatment.
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Detailed inventories can be obtained on application to Colonel D. E. Reid, Attorney for the Subscribers, at the Mine, or from the Subscribers, with whom or with Colonel Reid sealed Offers must be lodged not later than Wednesday, 31st inst.
A deposit of 1 per cent. should accompany each Offer. The highest or any Offer may not be accepted.
C. D. B. WALKER, C.A.,
W. G. DUNLOP, C.A.,
Joint Liquidators.
188, St. Vincent-street, Glasgow.
24th October, 1923. 3954

PUBLIC NOTICES

Aberdeen Corporation Water-WORKS.
EXTENSIONS, 1920.
CONTRACT NO. 14.—NEW AQUEDUCT.
The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the MANUFACTURE and DELIVERY of about 7 MILES of 40in. diameter PIPES and SPECIALS of the following alternative types, viz.:—
(A) CAST IRON.
(B) MILD STEEL (Lap-welded).
(C) REINFORCED CONCRETE (Spun and Ordinary).
The drawings may be inspected and specification, schedule of quantities, and form of Tender obtained on and after 7th November, 1923, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable and no specification will be given out after 16th November.
For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification, and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.
The employment of labour shall be in accordance with the conditions of the Unemployment Grants Committee.
Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for New Aqueduct Piping," are to be addressed to the undersigned. No Tender delivered after 5 p.m. on 26th November, 1923, will be considered.
The Town Council do not bind themselves to accept the lowest or any Tender.
GEORGE MITCHELL, M. Inst. C.E., F.G.S.,
Water Engineer.
Water Engineer's Office,
41½, Union-street, Aberdeen,
23rd October, 1923. 3919

Aberdeen Corporation Water-WORKS.
EXTENSIONS, 1920.
CONTRACTS NOS. 15 AND 16.—NEW AQUEDUCT.
The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the TRANSPORTING, LAYING, and JOINTING of about 7 MILES of 40in. PIPING and ANCILLARY WORKS between Crathes and Culter.
The drawings may be inspected and specification, schedule of quantities, and form of Tender obtained on and after 7th November, 1923, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable, and no specification will be given out after 16th November.
For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification, and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.
The employment of labour shall be in accordance with the conditions of the Unemployment Grants Committee.
Tenders, on the forms prescribed, and enclosed in securely sealed envelopes, endorsed "Tender for Aqueduct Pipe Laying," are to be addressed to the undersigned. No Tender delivered after 5 p.m. on 26th November, 1923, will be considered.
The Town Council do not bind themselves to accept the lowest or any Tender.
No person should Tender unless thoroughly experienced in the actual construction of extensive public works.
GEORGE MITCHELL, M.Inst.C.E., F.G.S.,
Water Engineer.
Water Engineer's Office,
41½, Union-street, Aberdeen,
23rd October, 1923. 3920

PUBLIC NOTICES

Metropolitan Water Board.
TENDERS FOR THE SUPPLY AND ERECTION OF TWO RECIPROCATING ENGINES AND PUMPS AT KEMPTON PARK PUMPING STATION, MIDDLESEX.
The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of TWO TRIPLE-EXPANSION DIRECT-ACTING, RECIPROCATING, ROTARY TYPE PUMPING ENGINES, cylinders approximately 30in., 50in., and 86in. diameter by 5ft. 6in. stroke, at their Kempton Park Pumping Station, Middlesex.
Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of fee at the offices of the Board (Room 173), Chief Engineer's Department, 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Thursday, 1st November, 1923.
Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of Three Guineas, which sum must be deposited with the Board's Accountant and will be returned on receipt of a bona fide Tender, together with all incidental papers. Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the "Metropolitan Water Board" and not to individuals.
Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Machinery, Kempton Park," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 31st December, 1923.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
22nd October, 1923. 3923

Midland Great Western Railway OF IRELAND COMPANY.
SLEEPERS.
The Directors of the above-named Company are prepared to receive TENDERS for the SUPPLY of 60,000 SCOTCH FIR (Home Grown) or, alternatively, 60,000 BALTIC RED WOOD SLEEPERS. Offers to supply smaller quantities of Scotch Fir Sleepers will be considered. Delivered either F.O.R. Liffey Junction or free on our wagons, North Wall Extension, Dublin.
Full particulars, specification, and Tender form can be had on application to the Company's Chief Engineer, Broadstone Terminus, Dublin. Tenders, endorsed "Tender for Sleepers," to be forwarded, addressed to the Chairman, Broadstone Terminus, Dublin, so as to reach him not later than 10 a.m. on Monday, 12th November, 1923.
The Directors do not bind themselves to accept the lowest or any Tender.
PERCY A. HAY,
Secretary.
Broadstone Terminus, Dublin,
18th October, 1923. 3898

The Bengal-Nagpur Railway COMPANY, LIMITED.
The Directors are prepared to receive TENDERS for: SPRING STEEL AND SPRINGS.
Specification and form of Tender can be obtained at the Company's Offices, 132, Graham House, Old Broad-street, London, E.C. 2, on or after 24th October, 1923.
A fee of £1 1s. will be charged for the specification, which is not returnable.
Tenders must be submitted not later than Noon on Monday, 5th November, 1923.
The Directors do not bind themselves to accept the lowest or any Tender.
By Order of the Board,
R. C. VOLKERS,
3924 Secretary.

PUBLIC NOTICES

State Electricity Commission OF VICTORIA.
TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.
Copies of Tender form and specification will be available upon application to
The Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.
SPECIFICATION No. 23/145.—4 ONLY 1000 K.V.A. SINGLE-PHASE TRANSFORMERS and SPARES.
CHARGE.—10s. for the first two copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 5s. each. This charge is not returnable.
PRELIMINARY DEPOSIT.—A preliminary deposit of £25 is to be lodged with Tender.
The specification may be inspected at the above-mentioned office.
The Commission does not bind itself to accept the lowest or any Tender.
Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 15th December, 1923.
R. LIDDELOW,
Secretary.
State Electricity Commission of Victoria,
3790 Melbourne, Victoria, Australia.

State Electricity Commission OF VICTORIA.
TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.
Copies of Tender form and specification will be available upon application to
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.
SPECIFICATION No. 24/1.—ALUMINIUM STEEL CORED CABLE AND ACCESSORIES.
CHARGE.—10s. for the first two copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 5s. each. This charge is not returnable.
PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.
The specifications may be inspected at the above-mentioned office.
The Commission does not bind itself to accept the lowest or any Tender.
Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 3rd January, 1924.
R. LIDDELOW,
Secretary.
State Electricity Commission of Victoria,
3789 Melbourne, Victoria, Australia.

State Electricity Commission OF VICTORIA.
TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.
Copies of Tender form and specification will be available upon application to—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.
SPECIFICATION NO. 24/2.—TRANSFORMERS, SWITCHGEAR AND ACCESSORIES, SUB-STATION "B."
CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract, specification, and drawings complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.
PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender. The specifications may be inspected at the above-mentioned office.
The Commission does not bind itself to accept the lowest or any Tender.
Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 19th January, 1924.
R. LIDDELOW,
Secretary.
State Electricity Commission of Victoria,
3922 Melbourne, Victoria, Australia.

The Great Indian Peninsula RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for:—

	Fee.
1. COPPER PLATES AND RODS	10s.
2. MILD STEEL BARS, SECTIONS, &c.	£1
3. STEEL TYRES FOR CARRIAGES AND WAGONS	10s.
4. PLATE GLASS, &c.	10s.
5. STATIONERY, &c.	10s.
6 DRAWN BRASS STRIPS	2s. 6d.

Tenders are due by 11 a.m. on 6th November, 1923. Tender forms obtainable at above address. Fees not returnable. 3944

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PUBLIC NOTICES

CONTRACT NO. 225.

The Directors of the Manchester Ship Canal Company are prepared to receive TENDERS from contractors experienced in heavy foundation work for the CONSTRUCTION and COMPLETION of the FOUNDATIONS for TWO TRANSIT SHEDS, Nos. 7 and 9, at Dock No. 9, at the Manchester Docks.

The Foundations are intended to carry two Reinforced Concrete Transit Sheds, each five storeys in height, by 450ft. in length and 110ft. in breadth, the construction and completion of which will form the subject of a subsequent contract.

Copies of the drawings, specification, bill of quantities, and form of Tender can be obtained at the office of the Chief Engineer (Mr. H. A. Reed, M. Inst. C.E.), 41, Spring-gardens, Manchester, on and after the 24th day of October, 1923, on payment of a deposit of Five Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, addressed to the undersigned and endorsed "Tender for Transit Shed Foundations," should be delivered at this office on or before 10 a.m. on Wednesday, November 7th, 1923.

F. A. EYRE,
Secretary.
41, Spring-gardens, Manchester. 3915

Waltham Holy Cross Urban DISTRICT COUNCIL.
MOTOR FIRE ENGINE.

The Urban District Council is prepared to receive TENDERS for the SUPPLY and DELIVERY of a NEW MOTOR FIRE ENGINE. Cost not to exceed £700.

Further particulars may be obtained on application to the undersigned, or will be posted on receipt of a stamped addressed foolscap envelope.

Tenders, sealed and endorsed "Tender for Motor Fire Engine," must be sent to F. C. F. Jessopp, Esq., Clerk to the Council, High Bridge-street, Waltham Abbey, not later than 5 p.m. on Monday, November 19th, 1923.

The Council does not bind itself to accept the lowest or any Tender.

W. C. HOLLOWAY, Assoc. M. Inst. C.E.I.,
Engineer and Surveyor.

Town Hall, Waltham Abbey,
October 22nd, 1923. 3925

Urban District Council of POULTON-LE-FYLDE.
SEWERAGE SCHEME.

CIVIL ENGINEERS and SURVEYORS are invited to write to the Clerk to the Council stating their experience and upon what terms they would PREPARE a comprehensive SCHEME and REPORT and FURNISH the necessary PLANS, SPECIFICATIONS and approximate ESTIMATES for SEWERING the area under the Council's control. Particulars as to the present sewerage scheme may be obtained from Mr. E. Prescott, Surveyor, at the Council Offices, Poulton-le-Fylde. Sealed applications, endorsed "Sewerage Scheme," are to be delivered to the Clerk to the Council on or before the 5th day of November, 1923.

J. B. GAULTER,
Clerk to the Council.
20th October, 1923. 3904

SITUATIONS OPEN

WANTED by Old-established FIRM in Midlands, engaged in manufacture of Pressed Steel Work, experienced WORKS PROGRESS CLERK.—Address, giving full details of experience, age, and salary required, P8236. The Engineer Office. P8236 A

WANTED by Mechanical Engineers in London, ENGINEER, with sound Machine Shop Experience on non-repetition work; £300 to £350, according to experience.—Address, 3946, The Engineer Office. 3946 A

WANTED, HEAD EXPERT DESIGNER for Woodworking Machinery, by first-class makers. Generous terms to suitable applicant.—Write, stating age, qualifications, references, and salary required, to Box 397, Willing's, 30, King-street, Covent Garden, W.C. 2. 3938 A

WANTED IMMEDIATELY for a College of London University, part-time JUNIOR ASSISTANT in the Engineering Department, to Take Charge of Drawing-office and to Assist in the Laboratory. Candidates must be between 21 and 24 years of age and must possess a good degree in science or engineering and have had some drawing-office experience. Opportunities will be given to a suitable man for higher work in the laboratory. Salary £120 p.a.—Write, "V. P.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 3918 A

CIVIL ENGINEER for Temporary Position, Leading to probable permanent pensionable appointment. A.M. Inst. C.E., fully qualified, REQUIRED for public service. Well up in details of Steel Work and Building Construction, Ferro-concrete and Sea Works, able to take off quantities, prepare detail estimates and specifications; must be a good draughtsman. Salary £300 by £15 to £450, with Civil Service bonus.—Address, 3839, The Engineer Office. 3839 A

ENGINEER. — SALESMAN - REPRESENTATIVE WANTED, London, Mechanical Handling Plant. Chief qualification, ability to get orders.—Address, stating experience, age, salary expected, 3868, The Engineer Office. 3868 A

EXPERIENCED ENGINEER WANTED, to Take Charge under agent of Large Sewerage Contract with sea outfall and house connections, South America. State experience and salary.—Address, P8151, The Engineer Office. P8151 A

FULLY QUALIFIED ENGINEER REQUIRED as REPRESENTATIVE, Far East. Steam and technical experience, good presence essential, minimum salary £750 per annum according to experience.—Address, giving full particulars, 3897, The Engineer Office. 3897 A

MACHINE TOOLS, LONDON.—Well-known British FIRM of MACHINE TOOLMAKERS REQUIRE in their London office a GENTLEMAN of good education and address with theoretical and practical training. Preference given to those with railway workshop experience.—Address, with full particulars of age, education, training, and experience, 3930, The Engineer Office. 3930 A

RATE FIXER REQUIRED for Electrical Firm near London. Must have experience of Polishing, Plating, and Impregnating Processes, Coil Winding and General Assembly Work. State age and salary required.—Address, 3896, The Engineer Office. 3896 A

TWO Experienced STRUCTURAL STEEL WORK DESIGNERS for Bombay, for probably two years; second-class passage out and home. Medical examination necessary. State salary and give references and particulars of experience.—Address, 3834, The Engineer Office. 3834 A

TEMPORARY CIVIL ENGINEERING DRAUGHTSMAN, age about 25. Must be Stud. Inst. C.E. or equivalent and have had thorough training as a civil engineer, with experience in Building, Steel and Ferro-concrete Construction and Sea Works, specifications, quantities and estimates. Must be neat draughtsman. Salary £250 by £15 to £350, with Civil Service bonus.—Address, 3871, The Engineer Office. 3871 A

WELL-ESTABLISHED FIRM of STEEL WINDOW MANUFACTURERS REQUIRE REPRESENTATIVE for London and home counties. Must have thorough knowledge of the trade.—Address, stating age, experience, and salary required, 3910, The Engineer Office. 3910 A

WORKS SUPERINTENDENT WANTED for Factory in London district, devoted exclusively to the manufacture of Electrical Measuring Instruments. Thorough experience of up-to-date manufacturing methods and organisation essential. State salary and experience.—Address, 3903, The Engineer Office. 3903 A

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SITUATIONS OPEN (continued)

WANTED (London), MECHANICAL DRAUGHTSMAN, General Factory Plant; some experience in Dairy Machinery essential.—Address, stating salary required, 3935, The Engineer Office. 3935 A

A WELL-KNOWN FIRM of Air Compressor Makers, manufacturing Turbo and Reciprocating Compressors, REQUIRE an experienced DRAUGHTSMAN, capable of Taking Charge of that section of their Drawing-office dealing with Reciprocating Machines.

Applicants should give full career, with dates, scientific attainments, age and salary required.
Address, 3940, The Engineer Office. 3940 A

DRAUGHTSMAN REQUIRED by FIRM of ENGINEERS; must be thoroughly experienced in working out plans for industrial plants, power stations and general engineering.—Please address, stating age, experience, full technical particulars and salary. P8208, The Engineer Office. P8208 A

DRAUGHTSMAN REQUIRED, with Special Experience of Mining Plant, Compressed Air, and Electrical Haulages. State experience, age, and salary required. Only experienced men need apply.—NORTONS (TIVIDALE), Limited, Tipton. 3901 A

DRAUGHTSMEN.—SEVERAL First-class, REQUIRED, fully experienced in Aeroplane Design. Also a First-class STRESS MAN, conversant with Air Ministry requirements.—State age, full particulars of experience and salary required, to the H. G. HAWKER ENGINEERING COMPANY, Ltd., Kingston-on-Thames. 3936 A

DRAWING-OFFICE MANAGER REQUIRED by high-class Machine Tool Makers; must be accustomed to modern practice. Good organiser and disciplinarian essential.—Address, 3953, The Engineer Office. 3953 A

REQUIRED for India, STRUCTURAL DRAUGHTSMAN, age about 24-30. Must be competent work out stress diagrams, design steel structures, also all-round first-class constructional knowledge. Colliery plant experience an advantage. Salary Rs. 600 monthly, including quarters.—Reply, stating age, experience, &c., to Box L. B., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 3902 A

SENIOR DRAUGHTSMAN REQUIRED for Chief Mechanical Engineer's Office on a Chilian Railway. Salary £420 p.a. Three years' contract, free passage out and home, free quarters provided.—Write, with full particulars, to "A. B.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 3947 A

SENIOR DRAUGHTSMAN WANTED, Able to Take leading position, thoroughly experienced in Drop Valve and Uniflow Engines and Steam Power Plants generally; knowledge of Colliery Winding Engines an advantage.—Address, stating age, experience, and salary expected, 3931, The Engineer Office. 3931 A

SHIP DRAUGHTSMAN (HEAD) WANTED by Shipbuilder in Shanghai, aged 35 to 40. Must have held similar position before. Salary commencing £540.—Address, detailing experience, P8221, The Engineer Office. P8221 A

PRACTICAL REPAIRING MECHANIC WANTED, to Take Charge Contractors' Plant on large contract, Georgetown, British Guiana. State experience and salary.—Address, P8150, The Engineer Office. P8150 A

SITUATIONS WANTED

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Scientific Addresses and the Press.

In proposing a vote of thanks to Sir John Dewrance for his presidential address at the Institution of Mechanical Engineers last Friday evening, Sir John Aspinall expressed the hope that the representatives of the Press present would see to it that the public was made fully informed of its contents, particularly with regard to the magnitude of the research work which it revealed as now being undertaken in this country. The Press, he implied, might do more than it did to encourage us to hold a good opinion of our own works and activities, and would be better occupied in reproducing Sir John Dewrance's address than in publishing some of the matter to which it gave its attention. The journalist who spent half his life-time drawing the long bow, it had been remarked, ought to spend the other half wearing the broad arrow. We trust that Sir John Aspinall will find no cause for complaint in the manner in which we have handled the President's address, and that we have escaped qualifying, in his opinion, for Dartmoor. We felt grateful to the President when, in responding to the vote of thanks, he extracted from Sir John silent assent to the view that the technical Press was above his censure, and that it was our brethren of the daily Press that he had more particularly in mind.

The Society of Technical Engineers.

The Society of Technical Engineers in 1921 claimed for its members, drawn from the technical and administrative staffs of British engineering firms, the right to be recognised collectively as the "third party" in the industry. The Society is a trades union, and maintains a position distinct from that of the employers on the one hand and that of the manual workers on the other. Its work at first met with little encouragement, both the other parties regarding its objects with mistrust or misgiving. While still working towards the removal of suspicion, or hostility, in accordance with its settled policy, the Society has decided that it would greatly help its work, advance the interests of staffs and promote industrial efficiency if staff councils were formed in every engineering firm of sufficient size. It does not intend that such councils should be formed solely from its own members. Its aim is simply to assist in their formation. Among the objects which, it is proposed, the staff councils should seek to attain are the general adoption of a scheme of superannuation which will not tie those concerned in it to individual firms, the establishment of a system of unemployment insurance for the staffs, the safeguarding of inventors' patent rights, and the adjustment of inequalities in conditions of service and rates of pay. The staff councils would also seek to secure the regulation of entry into the engineering profession, the registration of engineers and the recognition of the principle that only qualified technicians shall hold technical posts. These objects are those of the Society itself, so that the staff councils would merely be continuing locally the work which the Society is seeking to perform on a national basis. The councils, it is also proposed, would serve to assist the management by improving organisation and could do useful work in "smoothing the wheels of industry" when difficulties and disputes arise between the employers and the manual workers. The object of the Society in seeking to promote the formation of these councils appears to be to increase its own membership, and in particular to gain the adhesion of senior staff engineers.

Development of Commercial Flying.

Progress would at last seem to be in sight with regard to the formation of the National Air Company, the proposed company to be formed for running in future the subsidised aeroplane services of this country. The four existing companies operating organised air routes—Handley Page Transport, Instone Air Line, Daimler Hire and British Marine Air Navigation—have, it is understood, arrived at a common agreement, and negotiations have been opened with the Air Ministry. Some advance has also to be chronicled in connection with the development of the commercial aspect of the airship. Speaking at the Imperial Economic Conference towards the end of last week, Sir Samuel Hoare, the Air Minister, announced that the Government had accepted the Burney scheme in principle. The financial side of the matter, he said, had, in the main, been agreed, and he could see no reason why the scheme should not be agreed in full. He expressed himself as most anxious to have the contract signed as quickly as possible. The British Government, he said, had definitely decided to proceed with the scheme, but it would welcome any assistance towards its realisation from the Dominions. He assured his hearers that airship development had been proceeding in various directions during the past two or three years, and mentioned in particular the success achieved with mooring masts and the employment of an envelope of inert gas outside the buoyancy gas chambers, with the object of reducing the danger of fire. As a result of the discussion, the Conference decided to appoint a committee to discuss the Burney scheme with the Air Minister.

The Proposed North and West Motor Way.

The proposed new private toll road for fast motor traffic between London, Manchester and Liverpool, was described by Lord Montagu of Beaulieu at a conference held last Friday at Newcastle-under-Lyme. The original proposed route has been altered at an estimated additional cost of £200,000, so as to bring that town and others on the outskirts of the Potteries within its reach. Lord Montagu did not add much information to what has already been published regarding the details of the scheme, but he made several remarks bearing on the general aspects of road transport, which seem worthy of being recorded. One was that, judged by the standard of America, we, in this country, were only about one-third of the way towards our eventual motor vehicle equipment. Even with our present equipment, it would appear from another remark made by his Lordship, the number of passengers conveyed on the roads is five times as great as the number carried by the railways, while the road-borne tonnage is three times as much as the rail-borne. During the enormous developments of the past one hundred years, no new trunk road, he said, had been built, and in some instances the country was existing on the roads constructed by the Romans. These remarks were made to emphasise the necessity for the construction of the proposed motor way. As for its intended characteristic, namely, the facilities provided for high-speed traffic, he illustrated its value by stating that the saving of petrol, tires, brake shoes and time represented by an unchecked run, was estimated at 1d. per ton-mile.

An Orkney Fuel Factory.

We do not readily associate the Orkney Islands with the production of fuel of any kind. Nevertheless, if a scheme understood now to be in process of establishment achieves success, we may yet come to accept "Orkney patent fuel" as a commonplace of commerce. It is stated, although we have been unable to obtain confirmation of the report, that a London firm proposes to erect at Stromness a factory at which patent fuel briquettes will be manufactured from coal dust and colliery waste shipped from South Wales, the binding material being made from a special kind of seaweed found in enormous quantities near the islands. The Fuel Research Board, it is known, has been interesting itself in the utilisation of seaweed for industrial purposes, but it does not appear to have any connection with the Stromness scheme, its investigations, concerning which a report is now being prepared for publication, having been confined to the carbonisation of seaweed. We have confirmed the statement that Saxild and Partners, civil engineers, of Westminster, have received a contract for the erection at Stromness of a reinforced concrete pier, but this contract, we understand, has been received not from the London company interested in the patent fuel factory, but from the Stromness Harbour Commissioners, possibly, however, in anticipation of the increased activity which the establishment of the factory would necessarily bring in its train.

Training Foreign Railway Students.

While engineers in this country generally regard the entry of foreign students and apprentices into their works with a certain amount of indifference, or even disfavour, other countries, particularly the United States, definitely encourage such entries on the grounds of policy. It is argued that it is desirable to familiarise foreigners with a country's manufacturing methods and capacity, for when they return home they are much more likely to favour and to order products of the land in which they received their training than those of any other. The Institute of Transport has been interesting itself in this matter for the past eighteen months or so, particularly with reference to the training of foreign railway students. From its annual report, just issued, we learn that the Institute has received offers from certain British railway companies and manufacturers of railway equipment to provide facilities for the training of such students. A deputation from the Institute, some short time ago, waited upon the Parliamentary Secretary to the Department of Overseas Trade and received the assurance that a conference to discuss the whole subject would be convened among the Government Departments and parties interested in it. No date, we understand, has yet been fixed for this conference.

National Profit Sharing.

Speaking in Glasgow at the annual conference of Scottish Savings Workers, Sir Hugh Reid, managing director of the North British Locomotive Company, Limited, urged the establishment on a national basis of a profit-sharing scheme in industrial undertakings. He held that such a scheme on such a basis seemed to provide the only possible method of removing distrust and suspicion from the mind of the worker and of stimulating confidence and co-operative endeavour. One-half of all excess profits earned in all industries over and above a fair return on the capital invested in each undertaking should, he suggested, be retained by the employers, and the other half paid into a national industrial fund. From that fund payments would be made periodically through the Post Office in the form of dividends varying with the number and rating of the workpeople having claims upon it. Each worker's share might be determined by combining two factors, namely, the number of hours he had worked, and his hourly rate of wages, both factors to be certified by his employer. The dividends would be paid in addition to sums received by the workpeople under any scheme of payment by results. Industrial profit-sharing, he held, should be on a national, and not on a unit, basis, because the profits of businesses, even of those engaged in similar lines, varied considerably. The scheme is worthy of the well-known generosity of its author, but on the surface it would seem to us to require an unwieldy amount of machinery to carry it out, and to provide, possibly, a field for much labour trouble, and, moreover, would apparently penalise the well-managed firm for the sake of the badly managed.

The Great Western Railway and Unemployment.

The Great Western Railway Company's authorised programme on new works involves an expenditure of £4,500,000, and it is hoped that during the next six months about £1,000,000 of this sum will be spent. A very extensive programme of relaying is to be put in hand, which will call for 34,000 tons of steel rails. Capital expenditure to the extent of £2,269,700 is to be incurred on additional locomotives, carriages and wagons, and it is hoped to carry out heavy repairs to 1500 locomotives as compared with 762 in 1922, and to 20,000 wagons instead of 16,349. The number of carriages to be heavily repaired is about the same—4586—as last year. Steamer renewals to an amount of about £250,000 are proposed, and, in stores and materials for the whole system, requirements are to be anticipated and orders to the value of about £1,000,000 placed. A most interesting part of the company's proposals is the fact that it is prepared to construct three new railways at a cost of about £2,500,000, provided the State will render financial assistance similar to that given for the construction of roads under the Roads Act, 1920, and to the Nottingham Corporation for the improvement of the Trent Navigation. It is pointed out that in two of these three railway schemes there will be a loss of revenue to the company owing to the routes being shortened.

The London, Midland and Scottish Proposals.

In *The Times* of Friday last, that paper's Leeds correspondent recorded the dissatisfaction of the heads of big engineering firms with the railway companies' proposal to construct their additional locomotives, carriages and wagons in their own workshops, and not to place orders outside. The North-Eastern—the London and North-Eastern was evidently meant—was said to have placed orders outside its own shops, and that these orders were substantial and would bring great relief to the firms which secured the contracts and to their workpeople. It was also remarked that such shops as those at Crewe, Derby and Horwich were choked up with work. Some were working overtime, yet thousands of skilled engineers were idle. This report called forth a very important statement, which appeared in *The Times* of Monday, to the effect that it was not the policy of the London, Midland and Scottish Railway Company to extend the existing volume of manufacture in its own shops. The schemes which that company had in contemplation, it was added, were such that the company's plant would be quite unable to deal with the work even if the company so desired. The proposals of the London, Midland and Scottish Railway involved the expenditure of several millions, and were designed to benefit almost every industry in the country, as by far the larger proportion of the orders would be placed with outside manufacturing and construction firms.

The Boilermakers' Dispute.

The national conference called by the Boilermakers' Society met at York on Tuesday and Wednesday to discuss the situation arising out of its refusal to associate itself with the other shipyard unions in accepting the overtime, night-shift and holiday work agreement, as a result of which refusal its members were locked out by the Federation of Shipbuilding and Engineering Employers nearly six months ago. It was officially intimated after the conclusion of the meeting that it had been decided to submit definite proposals for the settlement of the dispute to the Trades Union Congress Mediation Committee. No details as to the nature of these proposals were disclosed, nor would the union officials even express an opinion as to whether the proposals opened up fresh hopes for a settlement or brought peace any nearer.

Science and Industry in America.

By WALTER ROSENHAIN, D.Sc., F.R.S.

No. VII.*

UNIVERSITIES AND COLLEGES (*continued*).

Michigan.

The University of Michigan at Ann Arbor, about 50 miles from Detroit, is in many ways a unique and remarkable institution. It is, in the first place, a State University, maintained by the Legislature of the State of Michigan out of public funds, and not essentially dependent upon foundations and private generosity. The university is a large one, the student body numbering 8000 or, if summer schools are included, over 11,000. Of these, although the University is freely open to both sexes without restriction, only about one-third or less are women, a fact which may serve as useful data when the suggestion is made that the granting of sex equality in universities must lead to their being "swamped" by women. In spite of the fact that the University is State supported, it is pleasing to find that large contributions and donations are frequently made to its buildings and funds from private sources. Thus the great "Union", or men students' club, probably the finest institution of its kind in the world, has been entirely built by subscriptions from the alumni of the University, while at the present time a large building intended to serve as a special club house for law students is also being erected out of private funds.

At the time of the writer's visit, the University, having put forward a request for a large amount of money for buildings and equipment, was being officially "inspected" by the State Legislature. Michigan, being mainly an agricultural State, the Legislature naturally consists to a large extent of farmer representatives, and it is good to find men of this type able and willing to appreciate the value of the work done by such a great University and ready to afford it satisfactory financial support. This support is regarded as only just sufficient for pressing needs by the authorities at Ann Arbor, but it would none the less arouse the keenest envy in many of our own colleges. During the speeches and discussions which took place in the presence of the visiting Legislature, one point of rather special interest emerged, a point typifying the fact that the States of the American Union are still to a large extent separate countries—one would almost say "nationalities" held together by a federation, but by no means merged into a single state. The University of Michigan, supported by State funds, at present opens its doors to students from other States, although a somewhat higher scale of fees is charged to those not resident in Michigan. There appeared to be some considerable doubt whether this was the right policy; whether, in fact, the benefits arising from this expenditure of Michigan money should not be confined to citizens of Michigan, students coming from other American States being, in this connection, spoken of as "foreign." The authorities of the University itself were, of course, quite clear upon the wisdom of freely admitting students from anywhere, and considerable and effective eloquence was devoted to pushing home to the visiting legislators the need for a broad-minded policy of this kind. That such an effort should be needed, however, indicates very clearly the existence of an intense and narrow "State" patriotism, a sentiment which was also reflected in some of the student songs that were heard on these occasions.

A modern State University of this kind and size naturally offers many points of interest to a visitor familiar with many universities in other lands, but these are only indirectly related to the subject here under discussion.

Turning to the scientific and technological teaching and research in the University of Michigan, principal attention was naturally devoted to metallurgy. The organisation in regard to this subject is somewhat remarkable. There is a large department of "Chemical Engineering," and metallurgy is regarded as a branch of that subject. While one can appreciate the fact that metallurgical processes in many cases involve problems of chemical engineering, yet the classification adopted by the University of Michigan appears rather to invert the natural order. Chemical engineering, in the sense in which the word is generally employed, would appear to be rather a subsidiary or auxiliary subject, no doubt of very great value and importance, but essentially of service to the chemist and metallurgist in carrying out his operations on a large scale. In practice, there can be no doubt that metallurgical teaching and research in this particular University has suffered considerably under the classification in question. Chemical interest undoubtedly dominates the department and metallurgy plays, relatively speaking, a minor part. That metallurgy has not suffered still more under this arrangement is undoubtedly due to the influence of one very striking personality, that of Professor E. D. Campbell. Professor Campbell's work as a metallurgist and metallurgical chemist is well known, but it is not so well known that for many years he has laboured under the very grave disadvantage of complete blindness. While experimenting in his laboratory on the gases evolved from steel when dissolved in various acids a vessel which he was examining closely exploded and irretrievably damaged both his eyes. In spite of this accident, he resumed his work at the laboratory only a few days afterwards, and has carried on his work as professor, both in regard to teaching and research, ever since. This really heroic effort and continued perseverance under grave disadvantages, together with a particularly charming and lovable manner, has gained Professor Campbell the affectionate admiration of all his students and colleagues. He is looked upon not only as a fine scientific worker, but also as a splendid example from the moral point of view. Reading, as well as personal, experimental work is, of course, out of the question for Professor Campbell, but by the willing services of some of his senior students, renewed from year to year, he is able to carry on his work and keep himself thoroughly informed of the progress of his science. While, therefore, for the reasons already indicated, metallurgy labours under serious disadvantages at Ann Arbor, the metallurgical division of the department of chemical engineering none the less forms a centre where the true spirit of research is cultivated, and some interesting and valuable work has been produced.

* No. VI. appeared October 19th.

Illinois.

The University of Illinois is situated in the little town of Urbana-Champaign, near Chicago. The term "near" is used in the American sense, the distance being not far from 200 miles. The little town of Urbana stands in the wide level plains of Illinois, in the heart of the wheat belt, like an island in the sea, and this somewhat isolated situation is definitely reflected in the character of the University itself. Here, even more than at Ann Arbor, the life and activities of the University are, to a considerable extent, removed from the industrial pressure which is exerted upon some institutions in the Eastern States, and the pursuit of learning and knowledge is considerably less hampered accordingly. There is, thus, an atmosphere of academic peace resting over these Western Universities which is strikingly absent from those situated in the larger towns or near the industrial centres of the east. At Urbana particularly this is marked by the general character of the research activities which are carried on. Perhaps the most striking of these, from the engineering point of view, is the Engineering Experiment Station mainly devoted to the study of the phenomena of fatigue. The work of Professor Moore with his various colleagues, including Kommers and Jasper, is well known. It is carried out under favourable circumstances, not only in regard to the point of view just mentioned, but also because the work is financially supported by various organisations, including the National Research Council, and latterly by the American Brass Research Association. Professor Moore holds a post of Research Professor, and is not burdened with any heavy teaching duties. Experimental work on fatigue of a most interesting kind is in progress, particularly in regard to endurance tests over very long periods of time. The results, on the whole, do not differ very widely from those obtained by other investigators, but will prove of immense value in correlating the modern comparatively rapid methods of fatigue testing such as those developed by Gough at the National Physical Laboratory and by Strohmeyer, with the results of endurance tests. The methods principally used consist in applying a uniform bending moment to a rotating beam specimen, but a number of other methods of applying fatigue stresses of various kinds are also in use, centrifugal and inertia forces being largely employed.

Other aspects of engineering work in which Professor Talbot is principally interested comprise the measurement of actual strains in engineering materials and structures under service conditions. One of the most interesting problems which has been studied, by means of an apparatus devised in this Laboratory, is that of the actual deformation of railway rails under the passage of locomotive wheels. This little appliance is attached to the underside of the rail and actually measures the extension of the portion of rail between the clamps of the instrument. The deflections are recorded upon a smoked glass disc on a very minute scale, but subsequent magnification is possible, and a very considerable degree of accuracy can be obtained. At first sight this instrument appears to be open to many sources of error, but actual experiment shows that these are not so important as might be imagined, and the resulting data are certainly of very considerable value and interest as showing the real extent of the service which rails are called upon to perform. Similar instruments can be, and, in fact, are, applied to the study of the strains in various members of bridge and roof trusses and other structures, both stationary and moving.

A department which has received particular attention at the University of Illinois is that relating to ceramics, refractories and glass. The work of Professor Washburn, formerly Professor of Physical Chemistry in this University, on the viscosity of glass, has already been mentioned. There is, also, a well-equipped department dealing with ceramics and refractories, although the furnace equipment does not appear to be particularly up to date. None the less, a large amount of important and interesting work is being carried out, principally with regard to the utilisation for various purposes of raw materials found within the State of Illinois. In an adjacent portion of the same building is arranged the cement and concrete laboratory, these materials of construction being of particular importance in that region of America.

In both the departments of Chemistry and Physics, the University of Illinois shows great activity in regard to research. Among the many researches in progress in the Chemical Department, mention may be made of the preparation in the pure metallic state of a series of the rarer earth metals. Salts of various rare earths were undergoing re-crystallisation and purification, and subsequently the oxides or suitable salts were submitted to a reduction process. Samples of many of the rare earth metals in the metallic state are available as the result of this work, and measurements of their properties and physical constants will be made when sufficient quantities have been obtained. In many cases, these materials can only be regarded as chemical curiosities, but it has happened more than once that a substance originally prepared merely as a chemical curiosity has ultimately proved of very great industrial value, the classical case of tungsten being, perhaps, the best known. Whether such metals as lanthanum or didymium are ever likely to prove of industrial importance, it is impossible to say at the moment. None the less, their systematic investigation and the exploration of their properties is of very great interest and importance, and should assist us materially in understanding the somewhat mysterious group of elements in question.

The Physics Department occupies a particularly well-arranged building, the whole central courtyard of which is utilised for what are termed "apparatus stacks." Actually, the central portion of the building constitutes a really great and well-arranged store of physical appliances, which are readily accessible from all the various floors of the building. This is so convenient an arrangement that it is surprising that it has not been applied elsewhere. Of the researches in progress here, mention can only be made of two. One of these relates to the production of "valves" for wireless or radio work. As a result of this research it has been discovered that the presence of the vapour of metallic sodium in a valve tube greatly facilitates the emission of electrons from the filament. In this connection it is interesting to see throughout this Laboratory a very small and neat type of vacuum pump in use. This appliance is made by a Chicago firm, and is known as the "Cenco" pump. It is claimed, and the investigators at Urbana support the claim, that this little pump, driven by a small motor, is capable of producing a vacuum of 0.001 mm. of mercury without an external backing pump. For higher degrees of exhaustion, however, some form of mercury vapour pump is widely used, either of the actual Langmuir design or modifications of it, which have been introduced by various other physicists.

Perhaps of more immediate engineering interest, and of particular interest from the point of view of public buildings recently erected in London, is the research work now being conducted by Dr. F. R. Watson in the Physics Laboratory, the head of which is Professor A. T. Carman. This deals with the acoustics of buildings and constitutes a continuation of the well-known work of Sabine. Dr. Watson, by an electrical apparatus, is able to measure the amount of sound which is reflected from and absorbed by various surfaces, and he has been able to show the effect of such factors as porosity, density, thermal conductivity, &c., in the material with which a wall is coated, upon the sound-absorbing properties. It is found that by the use of porous sound-absorbing materials of this kind, it is possible, very largely, to dull the reverberations even in a large empty hall. Provided that curved surfaces are avoided, and that a large proportion of the wall area is coated with sound-absorbent materials, the sound can be so much deadened that the hall would be unsuitable even for purposes of public speaking, while it would be altogether too dull for music. Accordingly, rules are being worked out determining the proportion of the wall area to be treated with sound-absorbing material for a given shape and volume of room or hall and for different purposes, more reverberations being desirable in a building intended for music than one in which speech is to be heard clearly.

General Observations.

In so far as it is possible to summarise the somewhat scattered observations, the general impression is that of great material resources and much energy and hard work. In many cases it seems, indeed, as if the work were too hard, as though the effort to produce results rapidly pressed unduly upon the minds and bodies of the workers somewhat to the disadvantage of their mental attitude towards the problems before them. Allowance must also be made for another factor. This is the great amount of work done at, and the really enormous resources at the disposal of, certain industrial research laboratories, such as those of the General Electric Company at Schenectady, and of such institutions as the United States Bureau of Standards. Some university men seem to fear that it might become impossible under

the conditions of university life to compete at all successfully with research workers having such very much larger resources at their disposal. It would be unfortunate if this point of view were to gain any great amount of hold upon the workers in universities either in America or elsewhere. There are, of course, problems which can only be attacked by the aid of very great resources, such as those which can be commanded by national institutions or great industrial companies. The field of scientific investigation, however, is very wide indeed, and it is no less possible to-day than it was a hundred years ago for an individual worker, even with comparatively little resources, to find a problem which he can attack with success and in the full hope of obtaining good results. This is a matter of men rather than machines or apparatus, and to a passing observer viewing the whole picture from a somewhat detached standpoint, it would seem that this aspect of men is the one matter of vital importance to American university life so far as scientific research is concerned. Buildings are provided in plenty, and equipment is, in many cases, excellent. Many individual scientific research workers of high standing are also to be found here and there in the universities, but there can be no doubt that on the whole the drain upon American brain-power which is exerted by industry and commerce is so great that it leaves a relatively small residuum to devote itself to scientific pursuits. This is, perhaps, unavoidable, to a certain extent, in a country of very great natural resources, where opportunities for the rapid amassing of wealth in industry and commerce abound. It is, however, a tendency fraught with grave danger to the progress of American science and its application to industry, and it is a problem which America will have to face very seriously. It is, perhaps, aggravated to a certain extent by the somewhat idealistic attitude of mind adopted by a certain number of university professors, an attitude which has already been referred to in the beginning of these articles. The need for the application of brain-power of the best quality available in a nation to scientific problems and their application to industry is, however, too great and of too supreme an importance to national progress to allow it to be seriously affected by such an attitude. It would almost seem as if, in the long run, the future, both with regard to science and industry and all that goes with it, including if necessary, predominance in war, must lie with the nation which knows best how to attract to scientific pursuits the ablest of its brains. If that attraction can only be exercised through greatly increasing the financial awards for scientific labour, then that position also will have to be faced, and it seems almost as though failure to face that position adequately were at the root of the scientific situation in America at the present time. If one takes any subject, whether pure or applied science, and writes down off-hand the names of, let us say, twenty leading men acknowledged as holding a first-rate position in that subject, the percentage of American men likely to be found in such a list will not be proportional to the relative population or resources of that great Continent. This is a plain statement of fact, and its truth will be readily admitted by American men of science themselves. It is, however, a serious criticism not of American men of science, but of American national attitude towards science and its utilisation. Had the pressure of war upon America lasted longer than it did, this attitude might have been changed, as it has temporarily been changed in England. As matters stand, it does not appear to be in process of changing even yet, and it is a matter for wonder how much longer it may yet take a great and intelligent nation like America to wake up to a realisation of this situation.

High-speed Rotary Planing.

By STAFFORD RANSOME.

No. III.*

THE HIGH SPEED ROTARY PLANING MACHINE.

In preceding articles we have dealt very fully with the theory and practice of rotary planing on modern lines and with the special cutter-blocks and cutters and the treatment to which they are subjected and which permit of these great increases in output. The effect of these drastic changes has been to enable the production, for a given quality of work, to be increased approximately five times, as compared with the outputs of the machines with square cutter-blocks, which, for nearly two centuries, had determined the speeds of rotary planing.

We now come to the question of the machines themselves. In general design, *i.e.*, in the arrangement of the spindles, feed rollers, pressures, &c., the high-speed machine does not differ from the others in any drastic manner. In detail of design, however, the two are very different. They have the same number of spindles, usually four, five or six. These spindles, except when each is driven by its own individual electrical motor, are driven from countershafts placed approximately in the same positions. Then again the spindles are driven no faster in the high-speed machines than in the slow, and so the diameters of their pulleys may call for no modification though their widths are naturally affected on account of the greater power required for the much heavier work. The same rules as to accessibility to all spindles, spindle adjustments, effective pressures and positive feeds apply to both type of machines. But both pressures and feeds are very materially modified, and in the latter especially the alterations are very marked. Then again there must be provision for a cutter "tracking" and sharpening slide for operating on each individual block.

If when all the conditions that we have explained as essential to the efficient working of the spindles, cutter-blocks and cutters have been carried out, the most difficult problem which the designer has to face is the feeding gear. Having to propel the wood between the cutter spindles at five times the rate of that required by the ordinary planer and to face a resistance increased from four to eightfold owing to the larger number of cutters that strike the wood in every revolution of the block, and to the comparatively obtuse angle of the cutter at its edge, the feeding gear must naturally be much more powerful. But this is not all. Of course, there must be no slip as, if the feed rollers revolve when the wood is stationary between them, even for a second, they grind grooves across the material which will be too deep for the cutters to remove when the wood resumes its passage.

SEVERITY OF PRESSURES.

The real difficulty is that to secure the positive feed the pressure exercised by the feed rollers must be very severe, whereas, on the other hand, it must not be so severe that it bruises or crushes the wood. This condition necessitates the use of feed rollers of very large diameter, so that they exercise a more powerful grip for a given amount of pressure, and for the same reason their number is often increased. Thus it is that there are frequently six or eight feed rollers when heavy cuts are required in hard woods. Similarly the diameter of these rollers is seldom less than 12in.

Although, for purposes of increasing the grip without accentuating the pressure, one cannot avoid fluting the feed rollers, or, at all events, some of them. The fluting in itself is a bad thing, because it indents the surfaces of the boards, thus rendering necessary more than a skimming surface cut to remove the indentations, especially in the case of soft woods which form nine-tenths of the material that is passed through the high-speed planer.

Naturally, it is only in the softer woods that the maximum speeds can be attained, not merely because of the rapid rise in power consumption of the feed motion to propel them against the cutters, which, of course, can be overcome by providing a sufficiency of power, but because the determining factor in the output of hard woods is the rate of feed which these highly tempered and consequently brittle knives will stand without breaking, gapping or cracking.

Another unavoidable imperfection in the high-speed planing of soft woods, and one which has puzzled many people, is due to the resiliency in the wood itself. We have mentioned in an earlier article that the surface of a soft wood board when planed at a very high speed, even when the cutters have been carefully tracked and the feed is positive and uniform and all the other conditions essential to success are properly fulfilled, sometimes varies in appearance in different places. This is often due, among other things, to the fact that the pressure of the feed rollers is so severe that the fibres yield to it so that the thickness of the board is actually reduced momentarily while it is subjected to that pressure. As the board leaves the feed roller, however, the elasticity in the fibres causes the wood to recover its original form. When wood is being worked at the rate of 5ft. per second, the board has been planed on all four sides, and is far away from the machine long before the fibres have completely recovered from the effect of the feed rollers, and the action of recovery was going on progressively while the wood was in the process of being planed. This recovery would not matter if the property of resistance to pressure were equal throughout the whole length of a plank. But it is not. Thus some parts are compressed more than others, and at the places where knots occur there may be no compression at all. This variation is accentuated in cases where the pressure or the action of the fluted rollers actually breaks the fibres in some places while merely temporarily squeezing them in others. A multiplicity of large diameter feed rollers, so that their better grip may permit of a less amount of pressure, is the only palliative to this evil.

The characteristic which we have been discussing is peculiar to the high-speed planer because in the ordinary machines there is comparatively little squeezing of the wood, and because the wood has from four to six times as long for recovery between the feed roller and the cutter-blocks. In the low-speed planer it has always been regarded as a virtue to place the feed rollers as close to the first cutter spindle as possible. The reverse is actually the case in high-speed machines for the reason given above.

VARIABLE FEED GEARS.

A feature which is inseparable from high-speed planing in any class of wood is an instantaneously variable feed motion which can be applied at any time while the wood is actually being cut. For reasons which are fairly obvious the variation must be from zero up to the maximum rate, and it must be totally independent of the action of the spindles of the machine itself. Moreover, it must be controllable from any point where the operator is likely to be standing in the course of his work, as if anything were to go wrong with the planing and it were necessary for him to go from one end of the machine to the other to stop the feed, a very considerable amount of valuable wood might be destroyed before he could do so.

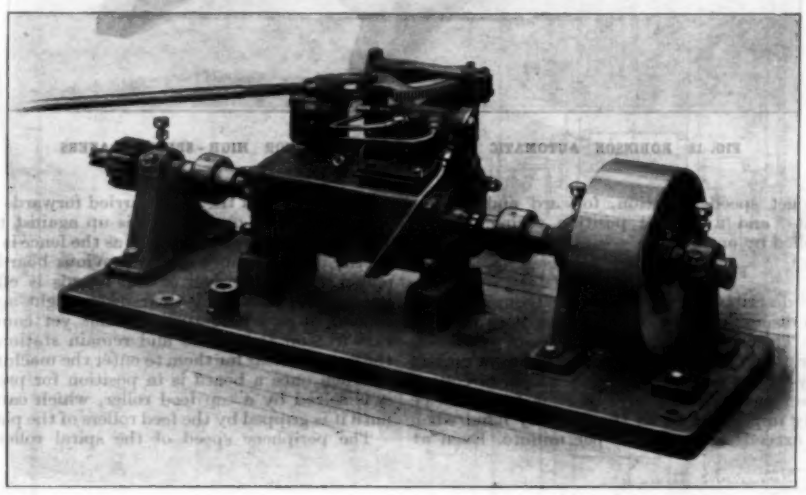


FIG. 11—WILLIAMS-JANNEY VARIABLE-SPEED GEAR ADAPTED FOR HIGH-SPEED PLANERS

The system for obtaining this immediately variable feed most generally adopted is the Lang variable V-belt feed. In this the V-belt, composed of a series of tapered hard wood blocks, runs between two pairs of adjustable conical friction discs, the members of which can be approached towards or withdrawn from each other as required, causing the tapered belt to run further from or nearer to the centres of the disc spindles as the case may be. It is the relative position of the belt in this respect on the driving and the driven discs which determines its speed, and, consequently, the rate of feed, for the time being. The disc adjustments are instantaneously effected by screw mechanism, which is controlled by a lever or hand wheel.

Messrs. Thomas Robinson and Son, of Rochdale, have recently introduced, for effecting a variable feed, a totally different process. This is a modification of the Williams-Janney hydraulic system, so well known in connection with the mechanical steering of ships. This apparatus, which is shown in Fig. 11, is well adapted for providing the variable feed for high-speed planers, as it is not only exceptionally powerful and reliable, but it is highly sensitive in handling, rapid in acceleration and speed reduction, and varies the speed to any required graduation smoothly and easily. Wear and tear are negligible quantities, as all the moving parts are immersed in oil. This gear consists of two similar hydraulic units, one unit fulfilling the function of a pump and supplying fluid (oil) to the other unit, which acts as a motor. The pump is driven at a constant speed in one direction by an electric motor, or by a belt from the line shaft of the planing mill, and the amount of oil it delivers to the motor is controlled

* No. II. appeared October 19th.

by a lever which varies the stroke of the pistons in the pump. The delivery of oil can be varied at will and instantaneously up to the full capacity of the pump. The motor unit, however, has a fixed stroke and, therefore, its speed depends upon the quantity of oil being delivered by the pump at any particular time. Consequently, the lever above mentioned controls the speed of the motor section giving a variation in the rate of feed from zero to the required maximum. Further, by reversing the controlling lever, the direction of the flow of oil is altered, and the motor unit will run in the reverse direction.

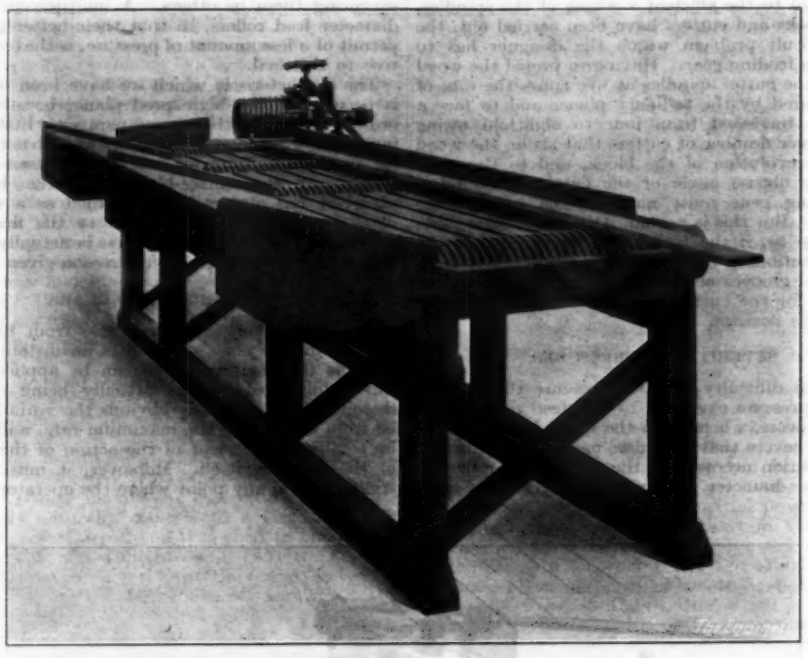


FIG. 12—ROBINSON AUTOMATIC FEEDING-IN TABLE FOR HIGH-SPEED PLANERS

Thus we get speed variation, forward and reverse movements, and a neutral position giving a stop, all controlled by one lever.

FEEDING-IN TABLES.

Before describing the machines themselves, it is well to discuss another essential accessory to their working. This is the preliminary process of presenting the material to the machine so as to assure a perfect continuity in the supply of boards, which, of course, has to be done mechanically, as it is found to be practically impossible to do the work by hand when the feed exceeds about 100ft. per minute. Even at that speed it requires a maximum of human effort which cannot be continued for any length of time.

There have been many designs of feeding-in tables of varying degrees of ingenuity and efficiency, but experience has reduced them virtually down to one type which, owing to its simplicity of action, has caused it to be adopted practically universally wherever high-speed planing is done. It differs slightly in design according to the maker, but in principle all of these tables are identical. The apparatus, which is shown in Fig. 12, consists of a long table, the front end of which is placed close up to the intake end of the planing machine. It has a fence aligned with that of the planer, and on to this table are placed, either thrown by hand or delivered by a conveyor, the boards to be planed by the machine. It matters not how the boards are placed on the table, whether straight or diagonally, or one on top of the other, or more than one at a time. It is the function of the table itself to adjust and present them properly and automatically, one by one, to the planer. This it does through the action of a series of driven rollers, the top surfaces of which project just above the table level. These rollers are fluted spirally with a lead towards the fence, so that any boards that come into contact with them are carried forwards and sideways until each one in turn is up against the fence. This action takes place as soon as the fence is available by the disappearance of the previous board into the planer. As the travel of the boards is effected by the friction caused by their own weight against the rollers, those whose turn has not yet come merely ride free on the rollers and remain stationary until the space is clear for them to enter the machine.

When once a board is in position for presentation it is seized by a top feed roller, which carries it on until it is gripped by the feed rollers of the planer.

The periphery speed of the spiral rollers on the table is rather higher than that of the feed rollers of the planing machine, so as to ensure continuity in the supply. As, however, the propelling action of the rollers in the feeding-in table is not positive, as explained above, the board, if fed forward too fast, is checked automatically by the aforementioned slip. As no care or adjustment is required in placing the boards on the feeding-in table, a single man can, by means of it, keep a planing machine supplied with boards at the rate of 300ft. per minute.

TYPICAL MACHINES.

We have chosen as representative types of high-speed planing machines, two, viz., one by Thos. Robinson and Son, Limited, of Rochdale—see Figs. 13 and 14 and page 443—and one by A. Ransome and Co., Limited, of Newark-on-Trent—illustrated by Fig. 15. Both are capable of attaining the highest outputs, but, while they both fulfil the general conditions laid down in connection with such machines, they differ considerably in design. Both will deal with hard or soft woods as required, but the Robinson machine is the more massive and powerful of the two, and is especially recommended by that firm for hard woods, while the Ransome machine is designed more particularly for the high-speed planing of flooring and matchboarding, the great majority of which is of soft woods.

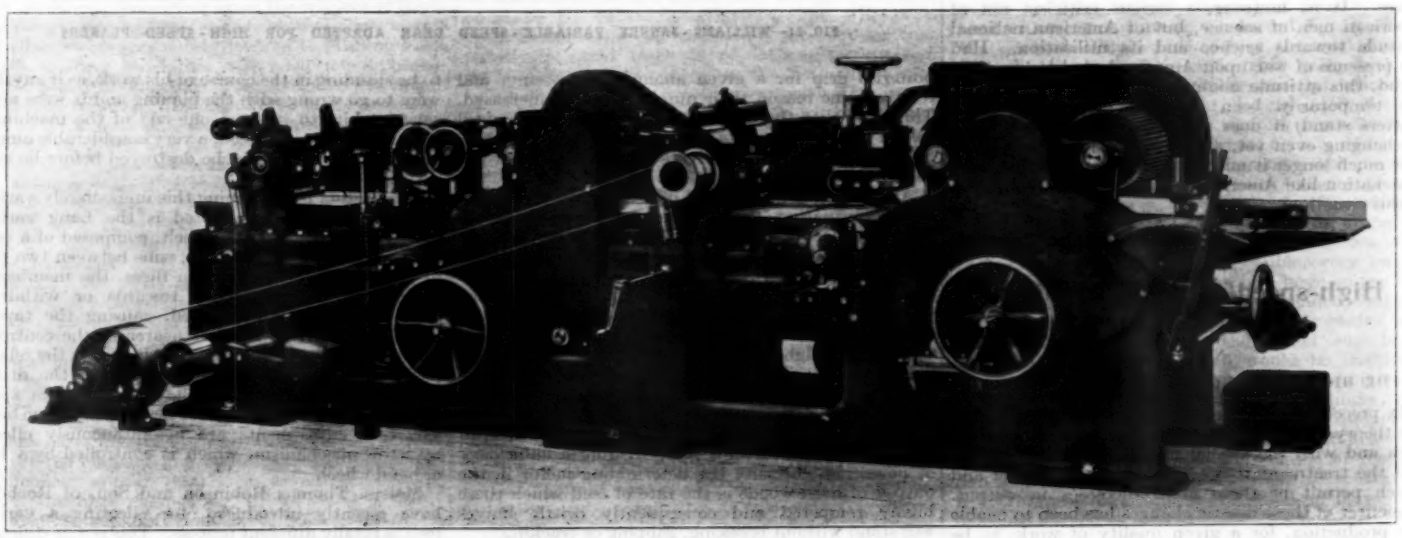


FIG. 13—THE ROBINSON HIGH-SPEED PLANER

The Robinson machine takes in material of any size up to 15in. wide by 6in. thick, and carries six cutter-blocks, viz., two top, two bottom, and two vertical side blocks. Its overall length, without its feeding-in table, is about 17ft.

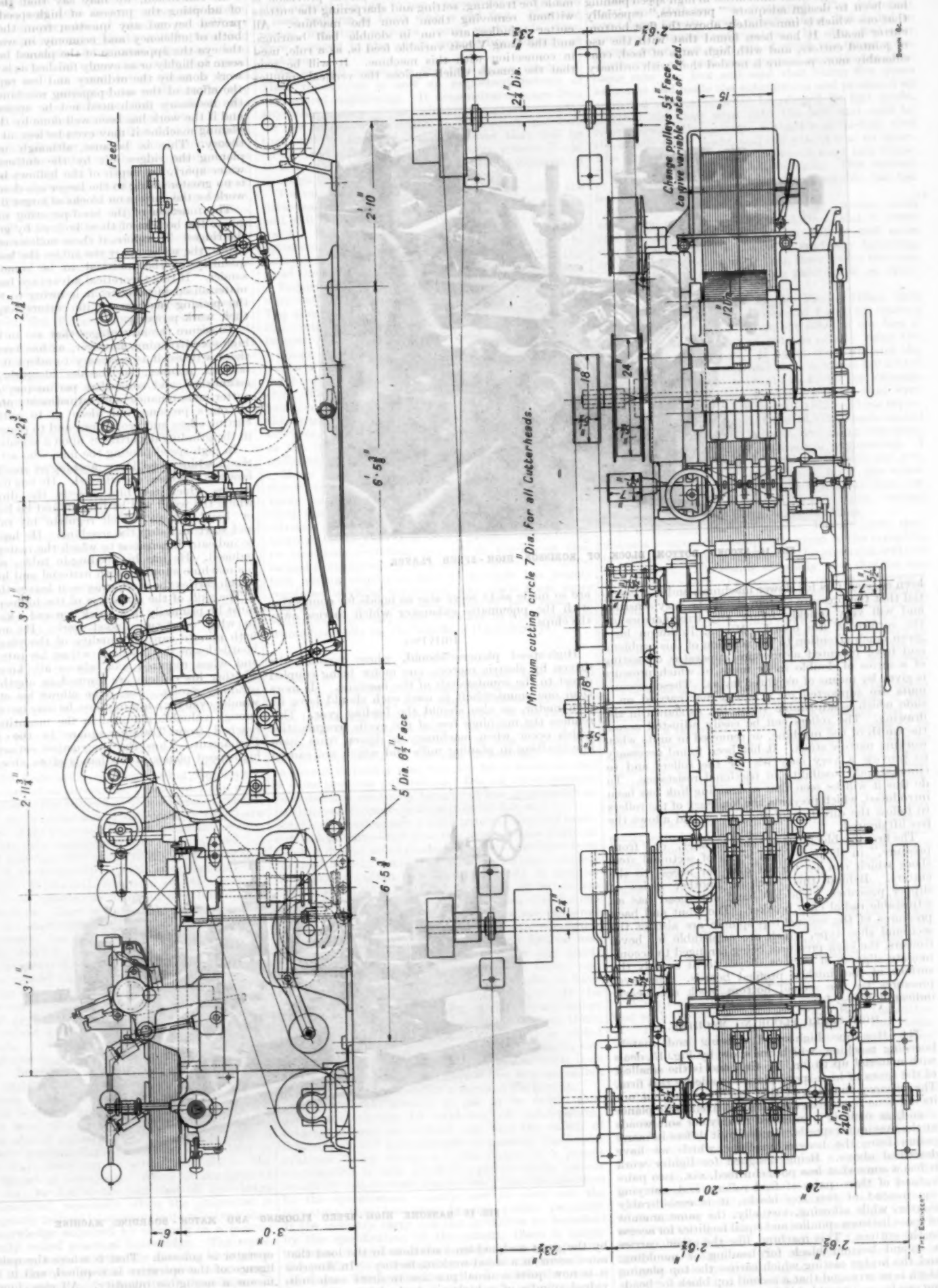
The cutter spindles are all mounted in double-row, self-aligning, dust-proof ball bearings, and the faces of all the spindle pulleys are grooved to prevent belt slip. The heaviest work naturally falls on the first top and bottom blocks, both of which can be double belted and are provided with self-acting belt tighteners. Each carries either six or eight knives and is provided with its tracking apparatus as described in the second article of this series. It will be seen that these two cutter heads are placed immediately between the feeding-in and feeding-out rollers. The first bottom cutter spindle is fixed in a removable drawer and possesses a new and improved feature in its mounting which has been recently patented. Instead of being supported on wedges, cams, or vertical screws directly below the head it is tilted about a half-round saddle or fulcrum on one side and supported by a rest and eccentric shaft on the other side, the eccentric shaft being provided to give the slight vertical adjustment necessary with the use of tracked cutters, and for completely lowering the head out of use when desired. Both the half-round saddle on the one side and the support on the other side, can be tilted slightly to level the cutters to the machine table. A very simple and effective system for securing or cramping down this cutter head after adjustment is provided.

The side cutter heads, which can be adjusted vertically or horizontally while the machine is in motion, are of the self-centring type, and are provided with their own tracking devices and automatic belt tightening gear. They are suitable for carrying either circular or any other type of block for plain edging, or for tonguing and grooving or profiling. The second top and bottom or profile spindles are arranged so that various types of cutter heads can be used. To enable changes to be easily carried out, the spindles are withdrawable from their housings. They have a slight horizontal screw adjustment to enable V or bead cutters to be set correctly in relation to the fence line. Tracking devices are provided for jointing both straight and moulding cutters. The second bottom spindle is at the extreme tailing-out end of the machine, and is best seen in Fig. 14, which shows the spindle exposed by the removal of its "pressures" and back table, both being swung away to admit of the "tracking" of the cutters. Accessibility to every cutter head is fully provided for in this machine.

The timber is fed through the machine by means of six rollers, all 12in. in diameter, four at the feeding-in end, and two after the first top and bottom spindles and before the side spindles. These rollers are driven by spur gearing, which is totally enclosed and so protected from chips. The feed can be driven by one or other of the variable feeds, already described, and controlled by a lever. Of the six feed rollers,

HIGH-SPEED PLANER FOR HARD WOODS.

THOS. ROBINSON AND SON, LIMITED, ROCHDALE, ENGINEERS



only the first pair, as a rule, is fluted. The others are plain. The pressure is applied to the top feed rollers by a patented system of weights, levers and chains.

THE PROBLEM OF PRESSURES.

One of the greatest difficulties in high-speed planing has been to design adequate "pressures," especially that one which is immediately above the first bottom cutter head. It has been found that with the use of jointed cutters, and with high rates of feed, considerably more pressure is needed than with ordinary keen edge cutters for slower machines, and it is essential that the pressure system should be very sensitive and will very quickly follow any irregularities on the surface of the board. Messrs. Robinson have given much attention to the solution of this problem, and have patented a pressure apparatus consisting of a series of double roller units to which pressure is given by means of weighted levers. These pressure units are supported on a square bar carried on a slide which is adjustable vertically, as shown in the drawing. The rollers can be easily adjusted across the width of the machine, or removed in units when working narrow stock. It has been found necessary to provide a very easy lift for the rollers and to eliminate all possibility of frictional resistance. To do this it will be seen that a straining link has been introduced, which prevents the tendency of the rollers to follow the direction of the timber and allows the free lift desired.

The first top block has a "chip breaker," or "front pressure," in the form of a series of sectional steel shoes which can be turned over for access to the cutters. Behind this block is another series of slipper pressures. The left-hand side head has an adjustable radial chip breaker. The front and back pressures of the second top spindle are also of the sectional shoe type, which are adjustable for bevel timbers, the back pressures being arranged to accommodate slippers of various shapes to fit exactly the surface of the finished profiled boards. The lever pressures for the second bottom block are clearly indicated in Fig. 14.

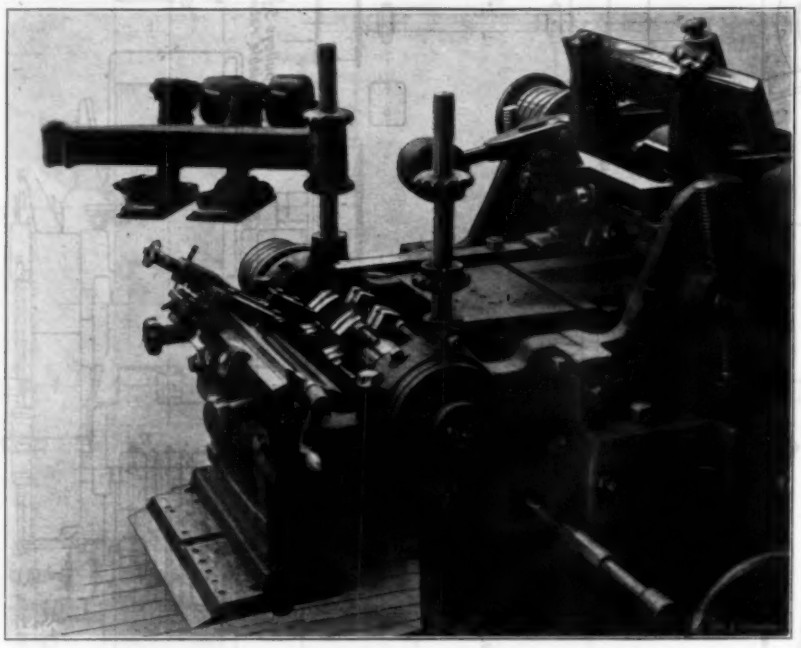


FIG. 14—SECOND BOTTOM BLOCK OF ROBINSON HIGH-SPEED PLANER

HIGH-SPEED FLOORING MACHINE.

The Ransome high-speed flooring and matchboarding machine, which we show by Fig. 15, deals with material up to 9in. by 4in., and is the smallest of the series of high-speed planers made by this firm. The primary function of this machine is to cut out its old-time rival—the cumbersome fixed knife planer—and, as such, it is intended mainly for soft woods at the maximum speeds. In design it differs in many points from the heavier machine which we have described above. Being designed for lighter work it has a somewhat less powerful feed, viz., two pairs instead of three pairs of feed rollers, and, carrying one instead of two top blocks, it is considerably shorter, while allowing, virtually, the same amount of space between spindles and equal facilities for access to the cutters. This machine, like the other, carries a second bottom block for beading or moulding, and the bridge casting which carries the top planing block is so arranged that a second top block for beading can be readily added if desired.

In the arrangement of its spindles and pressures, it has much in common with what is generally called American practice for high-speed planing, but it is more compact in design. It will be noticed that the vertical side spindles are placed between the top and bottom blocks, and that one of the vertical spindles is slightly in advance of the other, so that a side pressure may be applied immediately opposite the centre of the first vertical spindle. All the "pressures" and other accessories, whose positions would hinder access to the cutters, are easily removable, and for each of the cutter blocks provision is made for tracking, setting and sharpening the cutters without removing them from the machine. All cutter spindles are run in double ball bearings, and the Lang V-belt variable feed is, as a rule, used in connection with this machine. It will be seen that the guards which enclose the vertical spindles are so made as to serve also as hoods for connection with the pneumatic exhauster which carries away the chips.

DRIVING.

High-speed planers should, where possible, be driven by electric motors, one motor being coupled direct to the countershaft of the machine. If more than one countershaft is used each should have its own motor, as also should the feeding gear. This renders the machines free of the cyclic irregularities which occur when machinery is driven from main line shafting in planing mills and which are caused by the great and sudden variations in the load that must occur in a wood-working factory. In America it is now quite a usual practice to drive each individual spindle of a high-speed planing machine by its own electrical motor. This is an advantage, as it dispenses with all countershafting and abolishes altogether the objectionable belt strain which unquestionably affects the quality of the work detrimentally, though possibly only slightly. This practice is not usual in England, mainly because the standard motors available are not always suitable for direct coupling to these high-speed spindles, and the introduction of intermediate gear for increasing the speed would nullify the benefits of the individual drive.

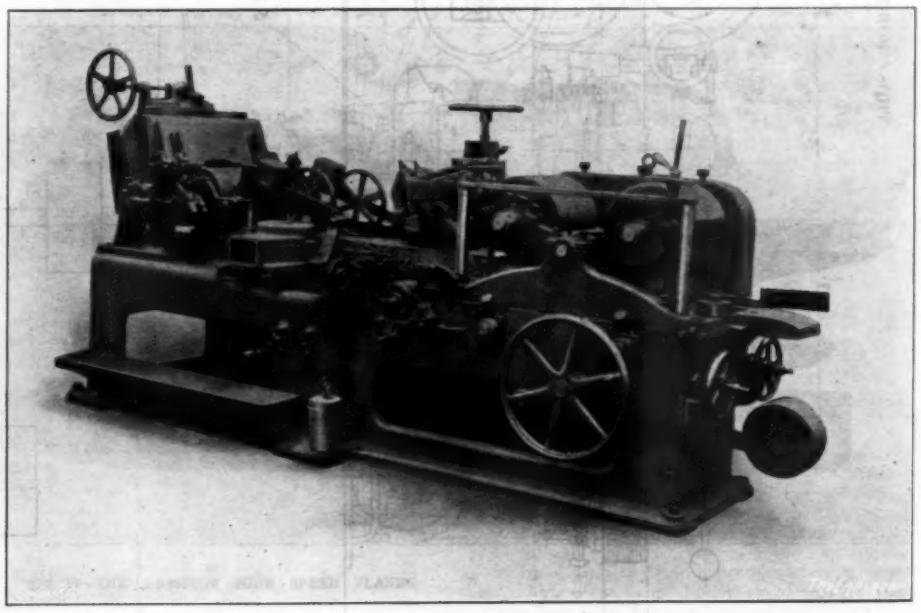


FIG. 15—RANSOME HIGH-SPEED FLOORING AND MATCH-BOARDING MACHINE

CONCLUSION.

In conclusion, we may say that the advantages of adopting the process of high-speed planing are proved beyond any question from the standpoints both of efficiency and economy in working. If to the eye the appearance of the planed board does not seem so highly or so evenly finished as is the case with work done by the ordinary and less rapid processes, the effort of the sand-papering machine in applying the necessary finish need not be appreciably more, and if the work has been well done by the high-speed planing machine it may even be less, at all events in theory. This is because, although in high-speed planing the ridges left by the cutters are spaced wider apart, the depth of the hollows between them is no greater owing to the larger arc described on the work by the cutters on blocks of larger diameter.

The function of the sand-papering machine is to get to the bottom of these hollows by grinding away the ridges. Therefore, if these hollows are of a given depth, the wider apart the ridges the less will be the quantity of the material to be removed by the sander. If this theoretical advantage has not always materialised in practice, it is owing to the fact that the planing machine or its cutters have not done their work properly.

To secure the advantages that are to be had from high-speed planing, however, as has been shown by these articles, it is necessary to adopt it in a whole-hearted manner, to forsake altogether the long established and somewhat perfunctory methods of cutter maintenance and adjustment, and to revise all one's preconceived ideas as to cutting angles, cutting edges and projections and to place everything in the grinding department upon a scientific footing.

In high-speed planing the man who actually works the machine need know nothing of mechanics or of how the processes are effected. He has his indicating gauges which tell him exactly the dimensions to which the wood will be planed, and he has his levers or hand wheels which regulate his rate of feed, and start and stop the machine. He has his gauges to indicate dimensions to which the material is to be reduced. He has his feeding-in table, which keeps his machine supplied with material and his conveyor which carries the stuff away as it leaves the machine.

The skill of the operative of the high-speed planer must lie primarily in a quick eye and a knowledge as to what constitutes good work. He must watch with minute care the quality of the planing as the boards leave the machine, adjust his rate of feed as and when required and, above all, know at once whether his cutters are gapped or anything else is seriously wrong. For, if he allows his attention to wander even for a few minutes, he may have destroyed enough valuable material in the meantime to have reached from Trafalgar-square to the Houses of Parliament. Thus the destructive capacity of the high-speed planer in the hands of an absent-minded operator is colossal. That is where the quick intelligence of the operative is required, and it is by no means a negligible quantity. All else, however, is done for him, or, at all events, it should be. The real brain behind the machine is the man who is responsible for the maintenance and adjustment of the cutters, and in a properly organised planing mill it should be his work, or the work of his department, to see to the sharpening, setting and tracking of the cutters on the machine itself.

We have already pointed out that it is useless to

attempt to get high-speed planing out of a machine which has not been specially constructed for the purpose. Never has the futility of "putting new wine into old bottles" been demonstrated more forcibly and with more disastrous results, than in this. The machines will not stand it. What can be done, however, and done to very great advantage, is to adopt for purposes of planing or ordinary machines the special cutter-blocks and cutters, and the processes in maintaining and adjusting them which are employed in connection with high-speed planing. This will at once bring about a great improvement in the quality of the work done on any planing machine and increase the speeds to the maximum of which the machine is capable.

We must always bear in mind that with high-speed planing, as with all other forms of rotary planing, the slower the feed the better will be the quality of the work. Consequently the utilisation of high-speed cutter-blocks and cutters, which increase the speed at which a given quality of work can be produced, will improve the work of any planing machine. Their use will also greatly improve the methods in the cutter maintenance department, and make the later introduction of high-speed planing by special machines, should the demand warrant it, a very much easier matter.

There are, of course, and there always must be, a very large number of factories where planing is done in which the demand does not warrant high-speed planing, or where the variety in the work renders it undesirable. This, of course, applies to all those factories where planing and moulding are done on the same machines indiscriminately, and the quantities of neither are sufficient to require working on the mass-production principle.

Institution of Mechanical Engineers.

ADDRESS BY THE PRESIDENT, Sir JOHN DEWRANCE, K.B.E., on Friday, October 19th, 1923.

When the Institution did me the honour of nominating me as President, it was just sixty years since I inherited the ownership of the firm of engineers that bears my name.

My father erected the Rocket for our first President, George Stephenson, assisted at its trials at Edgehill, and was afterwards locomotive superintendent of the Liverpool and Manchester Railway. The late Mr. Edward Woods was the engineer of the line, and he had a brother, Joseph, who started as an engineer in 1835. My father became associated with Joseph Woods, and at his death in 1842 changed the title of the firm to his own name, which it has borne ever since. My father died in 1861 and left me his business.

As I have been so long associated with the engineering industry, not only as a manufacturer, but as a member of the Management Committee and President of the Federation of Engineering Employers, and in various other directions, I feel that I can most usefully take as the subject of this address a general review of my impressions of the changes that have taken place in the past, and forecast, as far as possible, the direction such changes will take in the future.

When I went into the works nearly fifty years ago, accuracy of workmanship was the exception and was very costly. Whitworth produced accurate gauges, but they were regarded as more suitable for colleges than workshops. The war has taught us the necessity for, and, in many cases, the economy resulting from great accuracy, but the lesson has not yet been thoroughly learned.

In the seventies the lack of education of the practical men caused them to distrust those who had been better educated than themselves. These they classed as theoretical men, and difficulties of management and progress resulted. This distrust has not entirely passed away, but the spread of education has brought a greater appreciation of the value of knowledge and facilitated the introduction of improved methods. Industrial disputes in those days led to violence and frequently to bloodshed and military intervention. Disputes, unfortunately, still occur, but in the gigantic struggles that have taken place since the war, violence and military intervention have been almost entirely absent.

The very marked improvement in civilisation in the past fifty years can be attributed only to the gradual spread of knowledge. Some of our present troubles may be due to the fact that all knowledge is not beneficial, especially when the judgment is not sufficiently trained to appreciate its relative value.

The knowledge acquired by working in a factory is generally called practical knowledge. The workman, however, acquires from the drawing he is given to work to, knowledge that may have taken years of patient research and calculation to produce. If we were to limit our judgments or decisions to problems based on the practical knowledge obtained in the factory, very little would be accomplished to-day. It is the power of deduction that has enabled this nation to support a population very much greater than at the time when this Institution was founded. It is principally the engineer who has made possible the support of so dense a population by improving the means of transport. Further improvement will be needed if the population continues to grow.

I remember seeing one of the first electric light installations erected in this country. Since then have been added telephones, electric traction, power transmission, wireless and broadcasting. It was then against the law to use a motor car except with a man walking in front with a red flag. Now the motor industry employs more workpeople than were engaged in the whole engineering industry at that time.

We can all remember the first flying machines. Their production is now an important branch of mechanical engineering. It demonstrates more then any other section of the industry the great necessity for new knowledge to enable us to produce materials that will be stronger, motive power that will be lighter and safer, and wings to carry greater loads. It is impossible to see the limit of development of this new form of transport.

Torpedoes, the submarine, and its outcome, the paravane, have been developed to a wonderful extent, and still have great possibilities of further improvement. On the other hand, submarine listening apparatus, and other means of defence, may be improved in such a manner as to neutralise this great threat to our shipping.

Engineering establishments in my young days were very much more restricted in their operations. The shipbuilder, as a rule, built only the hull and sub-contracted for the rest. The engine builder bought his castings, and frequently the finished forgings, and sub-contracted for the boilers. Now we have large concerns that from the iron ore, coal, ingot copper, and imported logs, produce the complete ship. The reason for this expansion is that it facilitates co-operation and inspection, which override the many and obvious disadvantages. There is, however, a great deal to be said in favour of specialists in the production of parts if they can co-operate sufficiently with their purchasers.

Many engineering establishments were started by clever saving mechanics. Some broadened their views by taking great interest in the education of their young employees, and did all they could to advance the interests of the industry. There were, however, some that took every possible opportunity to introduce irritating and unfair conditions that caused ever-increasing difficulties to arise. Co-operation among employers and workpeople has largely regulated working conditions and made them more impersonal. Injustice and want of tact must be controlled more and more if we are to work together whole-heartedly for the benefit of the industry.

Patents.

Some of the large concerns of to-day were started to work patented inventions, but if we look back it is difficult to find very many of these inventions that became the standard productions of the industry when the monopoly expired. As time goes on and thousands of patents are filed in this country and all over the world, it becomes increasingly difficult to invent anything that has not been foreshadowed in some previous publication. During my experience patents have gradually become of less importance in mechanical engineering than they used to be.

Like my predecessor, I am a patentee, having taken out 114 patents—the first one when I was nineteen—but I do not mind confessing that some have been for small details. Others have been laborious exercises in deduction, often over a long period. A definite object is desired. Our own files are searched to see what has been done before, and then the Patent Office records are consulted. Sketches are prepared of various methods and discussed with colleagues likely to criticise. Many ideas get no further and are filed for record; others are made and tried, altered, and improved, perhaps, several times, and the result is exactly what one feels ought to have been done without all the trouble taken. If the article finds a ready sale, an infringer may adopt the converse process by searching the Patent Office and other records, and producing what is called a mosaic anticipation. One detail is shown in one patent, another in a second, and so on, until it is contended that with these before him anyone skilled in the art could produce the subject of the patent.

It has always seemed to me to be unfair that documents should be evidence of anticipation; evidence should be of prior use, and the extent of that use should be sufficient to prevent fraudulent evidence being accepted. The object of a patent specification is that when the period of the patent monopoly has expired, the industry may be informed by the specification exactly how to carry out the invention that has then become public property. If the industry carry out the invention as described by the specification of the patent, there is ample evidence of use, but in the large proportion of patents the public do not want to avail themselves of the privilege. The inventor used to be advised to make the wording of his specification wide enough to provide for possible improvements, and the document, when read as an anticipation of a subsequent invention, may be held to have a meaning that was never realised when the specification was prepared. I have known such specifications quoted forty years after being filed, during which period there had been no use in accordance with the specification.

If the industry have not exercised their privilege of use, and the subsequent inventor has eliminated the defects that prevented the previous patent specified from coming into use, surely he has good ground for claiming that he has produced a new manner of manufacture.

Only one of my patents has been adjudged in court, and that one was destroyed. The defendant cited over twenty prior specifications, but failed to construct a mosaic anticipation. He also cited over twenty prior users, only one of which was relied upon. Three very old men were secured as witnesses; one came into the box and said that thirty-five years before he had made the anticipation and produced an admitted replica of what he alleged he had made. Another old man went into the box and said he remembered helping him; a third said he had used the article when made, and the patent was no more. The firm that destroyed the patent went into bankruptcy long ago and ceased to exist. This method of destroying a patent is most dishonourable, but has been employed on several occasions.

Very few mechanical engineering patents come before the courts at the present time, and it seems probable that in the future they will be still more rare. The value of a patent is gradually becoming appraised on other grounds than the support that can be obtained under the existing patent law, as interpreted by the courts.

For 1922 the receipts of the Patent Office were £493,132 and the expenditure was £419,159, leaving a surplus of £74,073. When the total of the fees is divided by the number of patents of any value the tax is a very high one. If again the costs and the time spent by inventors and their advisers are added it is probable that it amounts to £1000 per valuable patent or more. There were 677 patents that were paid up for the sixteenth year in 1922. These represented only 4.2 per cent. of the 16,172 patents sealed in 1907. Of these 677 patents, excluding ordnance, less than 100 related to mechanical engineering. I have examined these and find they include my own and my company's patents, so I hope the other patentees will not take offence when I say that our members cannot be congratulated upon having acquired the right to use these 100 patents.

It is the fundamental idea of Patent Laws that unless a temporary monopoly is given to the inventor, the initial expense of exploiting the invention will not be incurred. Thousands of costly new designs are exploited without the assistance of the temporary monopoly. When we realise that only one mechanical patent in 10,000 is worth exploiting, and the industry has to bear the cost in brain power, fees, &c., it seems probable that it would be cheaper for the industry to associate to test designs such as is now being done for research, standardisation, and the other associated activities.

The chief difference between research and invention is that when conducted by an association of the industry the results belong to the industry, but the rights of a patented invention belong temporarily to the patentee. The mind of an inventor is liable to lose its freedom in designing. A preference is established for those designs that may become subject matter for a patent, rather than the standards suitable for adoption by the industry. The mind of the research worker should be quite free from any such restraint, the only object being the best possible result suitable for general adoption, and, in some cases, standardisation. It is remarkable that when fixing standards it is seldom, if ever, the British Engineering Standards Committee has wished to adopt an appliance that has been the subject of a patent. The activities of research associations, learned societies, technical colleges, and the British Engineering Standards Association, will undoubtedly increase and perform a great many of the duties that in the past were performed by patentees.

Research.

When I was quite young I formed a lifelong friendship with the late Dr. George Gore, F.R.S., the author of "The Art of Scientific Discovery," "The Scientific Basis of Morality," and many other published works. Dr. Gore implanted in me a great affection for scientific research. Although my education at the Charterhouse had been mainly classical, I had studied chemistry very thoroughly among my science subjects at King's College, London.

I started a research laboratory in 1880, and took over Professor Barff's assistants and apparatus, and worked up his process for protecting iron from rust. Lubrication experiments occupied a special assistant for a long time, and we succeeded in carrying Mr. Beauchamp Tower's results forward until a bearing was produced that showed 2000 lb. on the gauge when running in one direction and a high vacuum when run the opposite direction. Some of the results were published by the Institution of Civil Engineers many years ago, but the experiments are still in progress and my adhesion pump has been exhibited at our Institution Exhibition and in many other places. In this laboratory in 1882 an ingot of aluminium was produced by electrolysis at a time when the market value of that metal was so high that its use was very restricted. The properties of the alloys and the effect of the temperature at which they are poured into the mould were also studied.

The corrosion of marine boilers was at one time

very serious and was not fully understood. I worked upon this subject, and in a paper read before the Institution of Civil Engineers for which the Watt Gold Medal was awarded, I was able to explain the way magnesium chloride contributed to the corrosion, and the necessary tests and the remedy.

My laboratory grew to a 2-acre factory with a pier on the Thames, and I should still be manufacturing cyanides had not the German Government in preparation for the war decided to stop, if possible, all British production of cyanides. They sold in this country at a quarter of the cost to them, and I closed my factory on the Thames.

So far my research work was individualistic, but I did not give it up when I gave up my research laboratory, but in harmony with the tendency of the times I became interested in co-ordinated researches, and am now a member of many research committees. I hope by this "team" work to accomplish more for the benefit of the industry than could be done by working alone.

In the Middle Ages the research worker carried on at the risk of his life, but although he was probably attempting to produce the philosopher's stone or the elixir of life, he occasionally lighted upon new knowledge of great use to his fellow men and gradually laid the foundations of the present structure we call science. He was usually a solitary soul that worked alone. There is always a tendency to seek solitude when performing absorbing work, but the kind of work that can be done is strictly limited. Many research problems require consultation, access to complete records, costly and extensive plant, and scientific instruments. The recognition of this phase is to be found in our latest research institutions where there is an organised staff, with departments and buildings comparable in size with factories.

On July 28th, 1915, a Committee of the Privy Council for Scientific and Industrial Research was appointed by Order in Council, and a little later the Department of Scientific and Industrial Research was created as a new Department of State for the service of the committee. Under the Order in Council all proposals for research expenditure by the Committee of Council stand referred to an Advisory Council of scientific men for recommendation and report. The committee has published several reports which I can strongly recommend as giving a most complete survey of the subjects to which they relate. The objects of the department are "the organisation and development of scientific and industrial research." The method adopted has been to form committees and co-ordinating research boards of prominent specialists in each industry and Government Department who recommend researches that are worthy of financial assistance.

Grants are also made to start associations of industries, the object being to secure the co-operation of firms in an industry, or a group of allied industries, for the maintenance of their own research for the benefit of their industries. Every assistance is given to such associations where advice is needed to co-ordinate their work and in administration. The records of the Department are also of great value, as they may give information of work conducted at home or abroad which may not have come to the notice of an association. Co-operation is the essence of the scheme, and every year shows fresh directions in which "team" work in the widest sense can serve a useful purpose.

The National Physical Laboratory is managed by an Executive Committee under the Department of Scientific and Industrial Research, but work is carried out for our own Institution and for various associations and Government Departments. Reports have been issued annually since 1909, and their report for 1922 is of 227 pages, and is of the greatest interest. The work of the Department of Scientific and Industrial Research is not, however, confined to the engineering industry, and twenty-three research associations have been started, many of them for other industries.*

Standardisation.

In reviewing the past of mechanical engineering, it is evident that an enormous amount of energy and opportunity has been wasted in not having exercised more care in arriving at well-considered standards at the earliest possible time. Take railways, for instance. Had the British Engineering Standards Association been in existence, it might have prevented the great "battle of the gauges." The present gauge of 4ft. 8½in. was arrived at in the crudest possible way. Brunel quite correctly contended that it was too narrow, but, unfortunately, he went to the other extreme, and his broad gauge was too wide. No other railway followed the Great Western, and the inconvenience of not being able to handle traffic soon compelled that company to lay a third rail as far as Bristol. I can well remember the Bristol and Exeter and the Cornish railways when no stock other than the broad gauge had passed over their rails except in a trolley.

For years narrow gauge stock was built on broad gauge wheels and axles, until there came the eventful date when, in an incredibly short time, the stock was cleared off the rails and the rails closed to the 4ft. 8½in., and the broad gauge was no more. But the different railways that adopted the same rail gauge did not standardise their loading limit, and we have, to-day, stock that will only run on certain parts of the railway system because the tunnels, bridges, &c., will not take them.

It was probably for financial reasons originally that collieries and traders built their own wagons to their own ideas. The railway companies have now agreed upon a standard 12-ton wagon, but with the full knowledge that it will not enter many of the collieries and factories until they are altered.

Again, had the Standards Committee existed, Sir Joseph Whitworth would not have arrived at his standard screw threads without more consideration, and this applies to thousands of standards of limited application that hamper production.

No one who has not sat upon the Committees of the British Engineering Standards Association can fully realise the difficulty caused by the existing practice. An instance of this is that at the present time it is necessary to prepare standard pipes and flanges for higher pressure than 350 lb. per square inch. This requires greater thickness of the material of the pipe. The present practice is to think of steel steam pipes by the bore, and if this practice has to be observed in future, it will be necessary to vary the present standard outside diameters. This would involve the necessity of changing the rolls for each variation of pressure. The expense of doing this would be very great and, on small quantities, prohibitive. In busy times it might be a long time before the makers would have the opportunity of changing their rolls, and, probably, they would not quote for such pipes. The mandrel can be changed without difficulty. For these reasons it seems necessary to preserve the present standard outside diameters and vary the bore; that is, adding the extra thickness of material on the inside. In calculating the delivery of a steam pipe, the pressure, superheat, length, bends, and other considerations, have to be gone into carefully. If one size of pipe is not sufficient, the next larger has to be adopted. If the selection is as great as at present, it is quite unimportant whether the inside or outside sizes are standardised. It is hoped that engineers will choose the lesser evil, and depart from present practice to meet this new situation.

There are many who think that standards hamper progress; there are others who think it to their advantage to use their own threads, &c., so that renewals can only be obtained from them. Such firms have an implied contract to supply renewals, and after a time they find it inconvenient, or the British standard being specified, they have to keep a double set of standards.

The British Engineering Standards Association have, so far, published 190 standard specifications, and it is my strong recommendation to all mechanical engineers to become familiar with these and adopt them in their factories, contracts, specifications and designs. The greatest possible amount of co-operation has grown up with the British Engineering Standards Association. It was started by the engineering institutions, which are represented on the committees together with Government Departments, consulting engineers, manufacturers and experts on each subject dealt with, who all work together to obtain the best possible result.

In foreign countries standardisation is making progress, not, perhaps, so much in the direction of standard qualities of the materials used by engineers as in the smaller component parts. In this country attention has been directed more to the former than to the latter, and our members might do much to bring about further economy in the workshops of the country by surveying the broad field of mechanical engineering generally, and making suggestions to the British Engineering Standards Association for work of standardisation in this direction. The great ideal is, of course, to arrive at international standards, and this is coming. There is practically such a standard for the tubes of oil wells, and efforts are being made to get other international standards.

When man began to count, some counted on the fingers only of one hand, and had halves and quarters. There was not much trouble when the fingers of both hands were counted, and the inches on most of our rules are still divided into eight divisions. The trouble came when the thumbs were counted as well as the fingers.

During the French Revolution, the metric system was evolved, and all the world was expected to follow. The French did not adopt the yard or the pound, but the metre, an imaginary part of the distance from Paris to the North Pole, which, incidentally, was incorrectly estimated, and the kilogramme, a most impracticable substitute for the pound weight. This put huge difficulty in the way of international standardisation. Whether future generations will be able to deal satisfactorily with this difficulty, I do not intend to discuss. I have not introduced this very vexed question controversially, but simply to bring before our junior members the necessity for studying standardisation in detail and comprehensively as one of the great problems before our industry. It will require all the co-operation, all the knowledge and all the patience of which human nature is capable to solve this problem, but in the solution is great hope of progress.

The British habit of mind does not readily accept standard products, but prefers something made specially. This interferes with mass production. Buyers for export generally prefer the standard product, as it is more conveniently replaced. Our manufacturers have had many severe lessons which suggest that, in the future, countries that can accept and produce standard products by mass production will be the most successful.

There are very few, if any, factories where the designs and methods of production do not show great opportunities for improvement. When a change is contemplated, everyone should work in harmony to ensure that not only is the change in design or method an improvement, but that with the fullest knowledge that can be obtained at the time it is the best change that can be made. This is especially the case when the object is mass production, as the cost of the plant, jigs, tools and stock of rough and finished parts, make it very wasteful to institute any further change.

Great arguments are advanced against mass production and automatic machines, both by artists and skilled workmen. They contend that it eliminates the opportunity for individual skill. Other countries adopt it and find it a necessity. Without mass production we cannot produce enough at a price that will sell to enable us to import and pay for our food.†

* The President then gave some particulars regarding the work of the Industrial Research Association.

† The address concluded with a section devoted to the training of engineers.

SIXTY YEARS AGO.

In the course of a leading article in our issue of October 23rd, 1863, we expressed curiosity and a certain amount of concern as to what the Russians were doing in the matter of naval armaments. We were convinced that they were preparing for war and that their preparations were on the largest scale. A fleet of two hundred gunboats was, we find it stated, in course of construction in the Russian dockyards and in the neighbourhood of Cronstadt "iron-plated ships of the heaviest class" were being built. In Great Britain "numberless firms" were at work on machinery for the Russian Government. At Newcastle, for instance, an immense steam hammer, having a total weight of 550 tons, was being made for the Czar. At Birmingham a pair of hydraulic shears, weighing 24 tons, had just been completed, and on the banks of the Thames some unusually large and powerful armour-plate bending presses had been and were being made. But it was in the matter of guns that we expressed chief concern. Quite recently one of a number of 9in. cast steel guns ordered from Krupp's had been tested against targets of 4½in. armour supplied by John Brown and Co., of Sheffield. The gun, it was stated, had been fired seventy times without exhibiting a flaw and had easily punched clean holes through the Sheffield plates, the shell in one instance going through the target and at least a mile beyond it. We expressed alarm in view of these facts at our Government's adherence to the 68-pounder cast iron smooth bore naval gun, and deprecated the waste of more time and money on the experiments then being made with the heavy wrought iron Armstrong guns. "The principle of ringed structure with initial tension," we wrote, "is very beautiful in theory, but a single piece of metal, where admissible, is always preferable to a compound arrangement." As for the question of rifling, then a subject of hot debate, we expressed the view that in a naval action, fast and fine rifling, giving remarkable accuracy of shooting at a range of five miles was useless, and that there was only required such rifling as would keep an elongated shot end on and fairly to its mark over a range of a mile or so. The "whole Armstrong failure" ought, we concluded, to be thrown overboard, and if we could not make our own great steel guns, we should, like the Czar, place an order for a few hundred of them with Krupp's. The verdict of time has gone against our views in some respects, but our criticism of the slow progress being made in this country in the development of guns was no doubt timely and served a good purpose. This country at the time possessed vast stocks of cast iron guns and was about to add extensively to them. Wrought iron was favoured by some, either as in the Armstrong gun in the form of built-up tubes or as a tubular lining to the breech end of cast iron guns. Steel as a material in gun construction was just beginning to be employed in this country, but only on an experimental basis, whereas abroad it was being regularly and exclusively used in several important instances.

With the railway statistics for June last, just issued as a Stationery Office publication, the figures as to the traffic and receipts for the first half of the present year are now available. They do not make encouraging reading, but as the Ministry of Transport is not furnished with any particulars of the companies' expenditure, we shall have to wait until the end of the year to learn to what extent economies have offset the reduced revenue. The number of passenger journeys, excluding those made by season-ticket holders, actually increased, when compared with the first half of 1922, by 3.5 per cent.; but consequent upon a reduction in fares, the receipts therefrom were 9.2 per cent. lower. It is significant that 5.4 per cent. more train miles were run to carry the 3.5 per cent. more passengers. In freight traffic there was an increase of 23.2 per cent. in the tonnage, towards which general merchandise contributed 13.2 per cent., coal, coke and patent fuel 21.2 per cent., and other minerals 43.1 per cent. The receipts from the latter two classes were higher, but general merchandise produced 11.6 per cent. less, and so for the half-year freight traffic receipts are 2.3 per cent. to the bad. It is gratifying to note that, contrary to the example supplied by passenger traffic, the increase of 23.2 per cent. in tonnage was carried with only 12.4 per cent. more freight train miles, that the average train load was 134 tons, as against 126 tons, and that the net ton miles per engine-hour 462, as compared with 442.4.

PORTLAND CEMENT FACTORY AT MAKWAR, SUDAN.

A Portland Cement Factory in the Sudan.

By HENRY R. TUTTON, A.I.C.

The Makwar Cement Factory was erected by the Sudan Government in 1920–1921 for the purpose of manufacturing the cement required for the construction of the Sennar Dam on the Blue Nile and the Gebel Aulia Dam on the White Nile. The works adjoin the Makwar Station on the Sudan Government Railway, with which system it is connected by sidings running directly into and through the factory, and is some 2 kiloms. to 3 kiloms. distant from the site of the Sennar Dam, with which it is connected by means of a 4ft. 8½in. railway. The factory has a capacity of 1000 tons of cement per week.

The raw materials employed are an extremely hard and tough crystalline limestone and clay, both of which are obtained locally and are found in almost inexhaustible quantities. The limestone quarries are at Mashata, some 50 kiloms. to the west of the factory; the clay is dug from pits between the factory and Sennar, being found just under the black cotton soil. The quarries and clay pits are both directly connected with the Sudan Government Railway, by which means the raw materials are conveyed to the factory in trucks holding 30 tons. The composition of the limestone is as follows:—

Analysis of Mashata Limestone.

	Per cent.
Water and organic matter	0.36
Silica	2.14
Alumina	1.64
Ferric oxide	1.24
Calcium carbonate	93.22
Magnesium carbonate	1.26
Alkalies and loss	0.14
	100.00

The composition of the clay employed is as follows:—

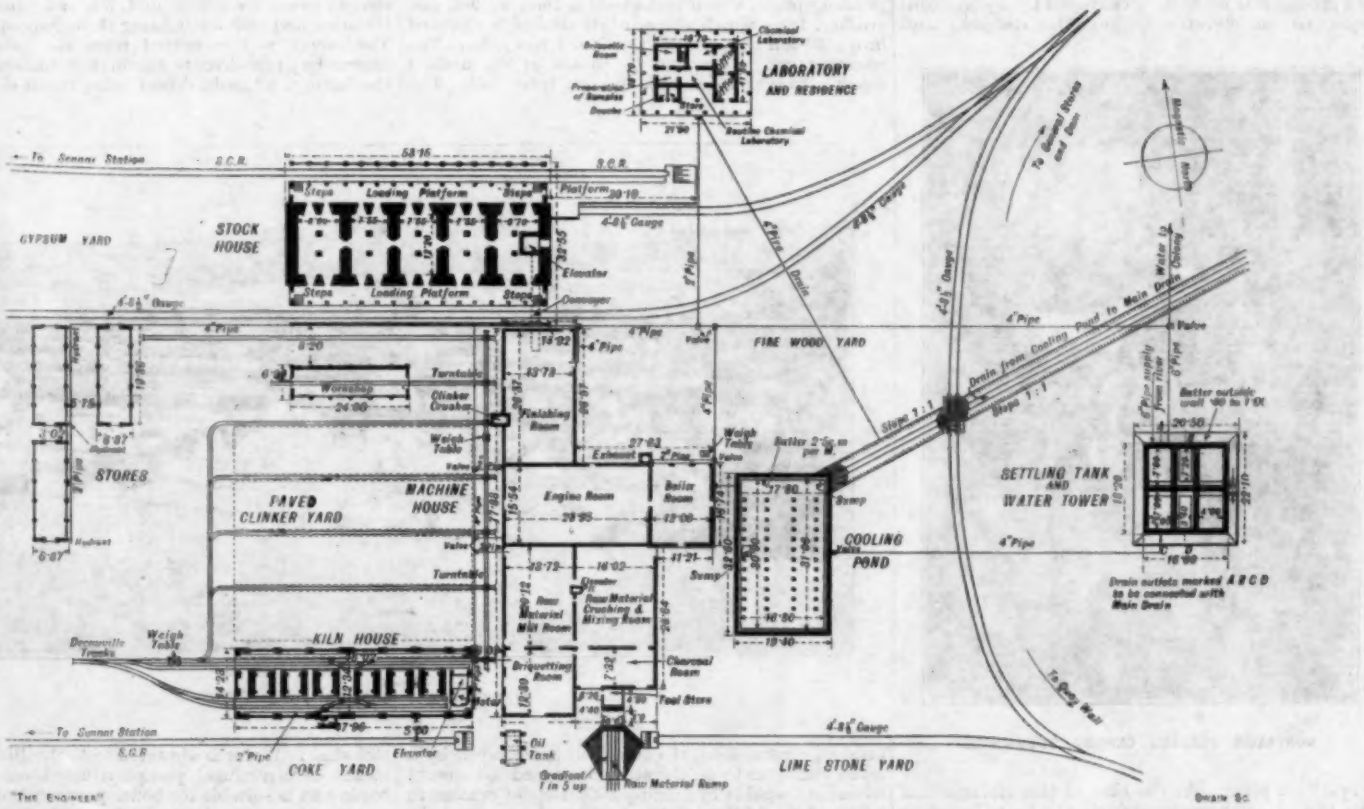
Analysis of Sennar Khor Clay.

	Per cent.
Loss on ignition	8.38
Silica	54.40
Alumina	20.02
Ferric oxide	7.97
Lime	6.24
Magnesia	2.87
Alkalies and loss	0.12
	100.00

The cement is manufactured by what is known as the dry process with shaft kilns; that is, the raw materials are crushed, dried, proportioned, and ground to an impalpable powder, then mixed with a proportion of powdered fuel, damped and pressed into briquettes before calcining to cement clinker.

At the first inception of the works the raw material proposed to be used was a white soft crystalline limestone, the nearest point at which a sufficient supply was to be found being at Roseires, some 250 kiloms. up the Blue Nile, and from which it was only possible to transport the stone by boat during some four or five months of the year when the river is in flood. Just as the factory was completed the limestone deposits at Mashata were discovered by Mr. Grabham, the Sudan Government Geologist, and as it was possible to transport this stone to Makwar all the year round by rail, it was decided to utilise those deposits instead of the Roseires stone. The raw material preparation plant, which had been designed to deal with the soft Roseires stone, was not capable of coping with the extremely hard and tough Mashata stone, and necessitated extensive alterations soon after the writer took over the management.

The limestone and clay are loaded by hand into 1-ton side-tipping wagons, which are hauled by means of a winch up a ramp to the crusher feeding platform. The crushing plant consists of two Baxter



PLAN OF THE MAKWAR CEMENT WORKS

crush down to 1in. The resulting crushed stone, together with the smalls from the grids, fall into an elevator which feeds two stone storage bunkers, each holding 50 tons of crushed stone. The clay is fed into a set of 24in. by 20in. clay crushing rolls, which feed direct into a 30ft. by 5ft. rotary dryer, heated internally by means of a wood fire. The dried clay is elevated into a clay storage bunker holding some 25 tons of this material. From the storage bunkers the limestone and clay are automatically

THE KILN-FEEDING FLOOR

extracted and proportioned by means of feed measuring tables, the scraper plates of which are adjusted to control the proportions of stone and clay required to make the necessary composition of the raw mixture. These feed tables deliver on a belt conveyor running to an elevator feeding a hopper, holding some 150 tons, over two No. 4 ball mills, which feed direct into two 26ft. by 6ft. tube mills, which grind down to a fineness of 8 per cent. residue on a 180-mesh sieve. The ground raw material is conveyed by a worm conveyor to an elevator feeding the damping and

CONVEYOR FEEDING CEMENT TUBE-MILL

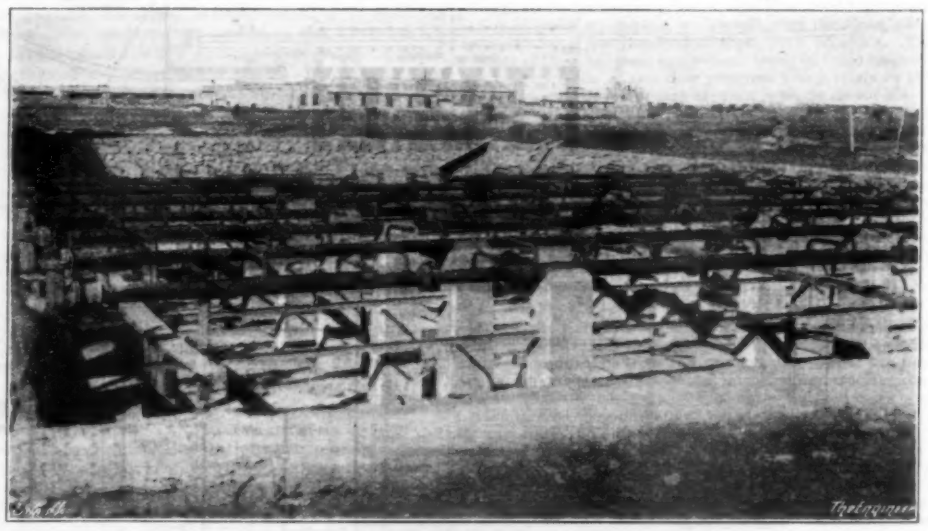
briquetting plant. At the base of this elevator is a fuel adding arrangement, which can be adjusted to feed powdered fuel to the ground raw material in any proportion up to 10 per cent. The damping plant consists of two 8ft. by 26in. Fawcett double damping mixers, which thoroughly incorporate the mixture of raw material and fuel with some 10 to 12 per cent. of water. The moistened mixture gravitates to either one of four Polysius drop stamp presses, which compresses it into briquettes or bricks, 10in. long by 4in. wide by 3¼in. thick, these briquettes having their corners slightly rounded. The briquettes are then loaded by hand upon trolleys, which are hoisted to the kiln feeding floor by means of a Smith-Major electrically driven lift.

The calcination is effected in what are known as continuous stationary vertical kilns working under forced draught. The kilns are six in number, 40ft. in height, and vary in diameter from 8½ft. at the top to 9½ft. at the bottom. Each kiln is surmounted by a short iron chimney 16ft. high. Air is supplied at intervals round the internal circumference of each

"DRAWING-EYES" OF SHAFT KILNS

kiln 15ft. from the base at a water pressure of 3in. to 4in., from two fans direct coupled to electric motors with variable control to regulate the amount of air supplied to the kilns. The briquettes are fed into the kilns by hand, together with about 6 per cent. of crushed coke, and a small proportion of coarse charcoal. The output of each kiln is 25 to 26 tons of clinker per twenty-four hours, with a fuel consumption of under 16 per cent. of coke and charcoal.

The clinker is drawn from the kilns by hand and conveyed in hand-propelled trams to the clinker grinding plant, which consists of a 16in. by 9in. jaw crusher, from which the crushed clinker is elevated into a 30-ton hopper over two No. 4 ball mills. The resulting grit is elevated by means of an inclined screw conveyor to a 30ft. by 6ft. tube mill. The



WATER-SPRAY COOLING POND

finished cement from the tube mill is conveyed by a screw conveyor to an elevator which feeds a series of five silos, capable of holding 6000 tons of cement in bulk. In addition there are warehouses on the factory capable of storing 10,000 tons of bagged cement. The bags are filled by hand, each bag holding 70 lb.

The major portion of the cement used in the construction of the Sennar Dam is what is known as "Red Cement," manufactured by intimately grinding together seven parts of cement clinker and three parts of homra. The homra is clay made into bricks and lightly burnt to a light yellowish red colour and so that it possesses puzzolanic properties.

The power plant consists of two Woodeson water-tube boilers supplying steam at a pressure of 200 lb. per square inch, and with superheaters capable of imparting an additional 200 deg. superheat to the steam, hand fired with wood fuel, working under induced draught caused by a motor-driven Davidson's fan discharging into a steel chimney 50ft. high. The feed water is heated by means of a Green's economiser of 160 tubes. There are two Uniflow engines of 600 horse-power each, jet condensing with drop valves, running at 145 revolutions per minute. The condensate is cooled by means of a water spray cooling pond with 300 spray producing nozzles, and is pumped by two belt-driven centrifugal pumps with a capacity of 1000 gallons each per minute. Electric power is generated by means of two hot-bulb engines direct coupled to continuous-current generators, each capable of producing an output of 100 kilowatts at 230 volts. A similar generator is also driven by a belt drive from the main shaft. In addition to the requirements of the cement factory, the plant supplies electric power for a flour mill, ice, and mineral water factories, and also for lighting the colony of Makwar. The power is transmitted from the two Uniflow engines by a rope drive to a main shaft running through the factory, all main drives being taken direct from this shaft. Water is obtained from the Blue Nile by means of centrifugal pumps situated on the river bank, and is suitable for boiler purposes without any treatment, except during the period of high flood, when the heavy red sediment is precipitated by alum in large settling tanks.

The equipment of the factory is completed by carpenters', blacksmiths' and fitting shops, which are well supplied with machine tools enabling all repairs to be carried out at the factory, also commodious analytical and physical testing laboratories. The factory buildings are constructed either of brick.

stone, or cement blocks, and are of more substantial construction than are generally seen in corresponding works in England. There is a well-laid-out system of railway sidings, both S.G.R. (3ft. 6in.) and standard gauge (4ft. 8½in.); and, in addition, each department is connected up to a Decauville tramway. The finished cement has the following average composition :—

	Per cent.
Loss on ignition	1.04
Insoluble residue	0.90
Silica	21.58
Alumina	5.60
Ferric oxide	3.78
Lime	62.96
Magnesia	1.63
Sulphuric anhydride	1.68
Alkalies and loss	0.83
	100.00

and the following average physical tests :—

Tensile Strength.

	lb. per sq. in.
Neat cement—	
Seven days	550
Twenty-eight days	700
Sand and cement, 3 to 1—	
Seven days	240
Twenty-eight days	350

Fineness.

0.3 per cent. residue on a 76 × 76 sieve
10.6 „ „ „ 180 × 180 „

Soundness.

Le Chatelier test. 2 mm. expansion.

The factory was erected under the supervision of Mr. O. L. Prowde, A.M. Inst. C.E., of the Ministry of Public Works, Egypt, Resident Engineer of the Gezira Irrigation Scheme. The chief contractors for the machinery were Messrs. Sayer and Colley, Cairo. In addition to the makers above noted, the general cement plant was supplied by Messrs. Fletcher, Derby; the boilers and feed pumps by Messrs. Clarke, Chapman, Gateshead-on-Tyne; the Uniflow and hot-bulb engines by Messrs. Robey, Lincoln; and the electric motors and switchboard by the Electric Construction Company, London. The buildings were erected by the Sudan Construction Company, Makwar.

The Shoe and Leather Fair.

The Shoe and Leather Fair, which opened on October 8th at the Royal Agricultural Hall, Islington, and which was largely attended throughout the whole of that week, was the twenty-fourth of its series. Since the war the Fair has been controlled by a society of the trade, upon the Council of which all the principal trade organisations are represented. In accordance with the Council's arrangements, the machines used in the actual manufacture of boots and shoes are only exhibited every second year, the intervening years being devoted principally to leather working and shoe repairing machinery, such as was shown this year. It follows, therefore, that the examples we have chosen for description are mainly machines used by tanners and curriers in the preparing and finishing of skins and hides.

Leather Rolling Machines.

Edward Wilson and Son, Limited, of Bootle, Liverpool, showed two kinds of leather rolling machines, which are used for the working of butts, bends and whole hides and for the offals or outer parts of the hides which are less uniform in thickness and require special treatment. The illustration Fig. 5, page 452, shows the Wilson improved twin bed rolling machine, which, originally designed for the first rolling of leather, is now also used as a finishing roller. It is made in two sizes, one for rolling butts and bends for the English market, with a 7ft. 6in. stroke, and another for the treatment of sides and whole hides for colonial and foreign markets with a 10ft. 6in. stroke. The leather to be rolled is gripped between an upper roller with an adjustable backward and forward travel, and the machine bed, which consists of twin cast iron beams placed side by side with their upper surfaces formed of polished zinc plate riveted to the cast iron. The beams oscillate upon yoked fulcrums, which method of support enables them to conform to the inequalities of the leather. The distance between the roller and the bed is regulated by adjustable stops controlled by a foot lever. A roller, 14in. in diameter, made of hard phosphor bronze, with rounded ends so that it does not mark the leather, is used, and it is mounted in a carriage drawn to and fro across the bed by steel chains. Along the top of the machine there is a bar with safety stops, which, by means of sliding tappets, throw over the balanced reversing arrangement and automatically reverse the roller at any desired distance from the centre of the machine. A hand-control lever is also fitted so that the roller may be started, stopped, or reversed independently of the tappets. Two long springs, working with a system of compound levers, apply the pressure, the length of the spring imparting resilience and giving uniform pressure on material of unequal substance. By turning a hand wheel the pressure may be increased from a few pounds up to 4 or 5 tons. The power required to work the machine is comparatively small, only about 2 horse-power being used.

A different type of machine is that illustrated in Fig. 1, which is used for rolling offals. In it the position of the treadle fulcrum can be altered to give a variable leverage, and the pressure exerted, which is independent of the distance to which the rollers are separated from each other, can thereby be controlled. By means of a rolling fulcrum fitted at the end of the treadle lever and under the pressure weights, a greater leverage is obtained at the beginning of the treadle stroke when the operator's knee is bent than at its finish when his whole weight is available. The top roller is made of phosphor bronze, and it is fitted into a yoke of special construction, which oscillates from a point of suspension close above the roll. By this means the endwise motion given by a longer suspension is avoided. Adjusting screws are provided, enabling the top roller to be raised or lowered relatively to the bottom roller without affecting the position of the treadle. The machine is built in two sizes, with a 3ft. and 4ft. jaw respectively, and is very robust in construction. The bottom roller consists of a stout gun-metal ring fixed to a cast iron hub and well supported in heavy gun-metal bearings.

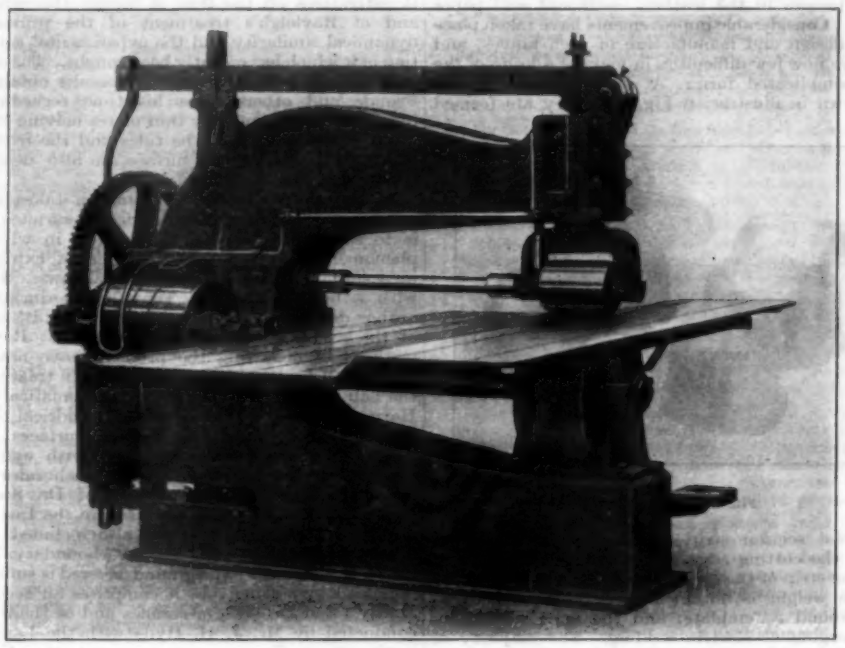


FIG. 1—WILSON ROLLING MACHINE FOR LEATHER OFFAL

A Double Band Scouring Machine.

One of the most interesting exhibits shown on this stand was the double band scouring and setting-out machine—see Fig. 6, page 452. It is used for removing the bloom from the surface of the leather which is often present when the hides come from the vats and also for imparting a surface finish. The hides pass into the machine over a series of wooden strakes, and are carried forward by horizontal feed rolls of small diameter, which are slightly inclined and curved. The makers claim that the rolls are much the same shape as the old-fashioned pinning beam, which was used in the hand process, and that the smallness of the roll diameter helps to open the grain of the leather and allows the bloom to be removed from it more readily. They claim, also, that the narrow surface upon which the scouring tools work enables the smallest hollows and creases to be bottomed, while the grain remains uninjured and scouring and setting-out is accomplished without loss of substance and darkening of colour. There are two tool bands, made of camel hair belting, upon which the hexagonal-shaped tools are fastened in aluminium holders. The tools are made both in hard bronze and carborundum, and when required fine brass wire brushes, fitted in aluminium stocks, are also fitted to the tool band. In the view we show, the belts are in the working position, and they are held in this position by a treadle motion fitted with an automatic catch and release. The tools are prevented from touching the feed rollers by guide rails, which also serve the purpose of making the tool belt conform to the roller curvature. The speed of the belts may be regulated, and the direction of their motion is reversible. Additional pressure can be put on the leather which is being worked by tightening a spring adjustment on the belts. Only about 1½ horse-power is required to drive this machine, and as the motion of the tools on the leather and the leather through the machine is continuous in direction, its capacity is high. In an actual test, upwards of eighty bends, we are informed, have been scoured within one hour.

A Leather Measuring Machine.

One of the prominent machines on the stand of the Turner Tanning Machinery Company, Limited, of Bramley, Leeds, was the 64in. precision leather measuring machine "Primesma," which was described in The Engineer of October 20th, 1922. This machine is now being made at Leeds in 64in., 88in. and 128in. sizes. It may be recalled that the leather, when passing through a pair of rollers, depresses a series of pin wheels spaced 1in. apart, and having pins set in their periphery also at 1in. apart. This arrangement has the effect of dividing the area to be measured into square inches. Each pin when depressed actuates a worm, putting tension on a series of thin steel bands passing over pulleys connected to a system of integrating levers. Thus the exact area of the irregular shaped skin or hide is read directly on a graduated dial. As soon as the leather has passed through the machine a treadle is depressed and the pointer returns to zero. The capacity of the machine is such that four to five hundred skins or eighty to one hundred hides can be measured in an hour. The London Chamber of Commerce is installing a 128in. machine for the use of the trade, and a 96in. machine has recently been acquired by the Kettering and District Boot and Shoe Manufacturers' Association for the joint use of its various members.

A Clamp Staking Machine.

Fig. 4, page 452, shows another machine built by the same makers, which attracted considerable attention. It is used for staking or softening the leather, and is termed a clamp staking machine, because the work is automatically clamped to the table by a felt-covered arm, while the staking tool is working upon the skin, thus allowing the machine to be worked by an unskilled attendant. The staking tool is a flat steel plate rounded at the edge and both ends, which is depressed into the leather so as to form a wrinkle or fold in it The fold so made is then drawn down the whole length of the skin by the downward motion of the knife. At the bottom of the stroke the knife is automatically released and is returned to its top position, where it again descends upon the skin, and the operation is repeated. At the completion of each stroke the clamp opens, allowing the material to be moved along the worktable. The pressure of the tool is regulated by a wide foot treadle placed at the front of the machine. An interesting part of the mechanism is the staking head or tool holder, which runs in double guides and is moved up and down the inclined table by a series of levers and a crank motion. Various adjustments are provided, so that the tool can be moved in any direction, and with the control provided the makers claim that the tool is so resilient in its action that its sensitiveness and the effect on the leather cannot be surpassed even by hand work.

A Boarding and Softening Machine.

This newly designed machine, see Fig. 3, page 452, is said to produce a most perfect imitation of hand work, and it is largely used in the preparation of motor hides. It consists essentially of two cork-covered rollers about 2ft. in diameter, both of which revolve in an anti-clockwise direction, as seen from the front of the machine. By an ingenious mechanical arrangement the leather when placed over the table is carried forward to the middle of the rollers, the skin being folded as it were in half. A further movement of the machine brings down the top roller so that the leather fold is gripped and at the same time the steel table recedes about 2in., allowing the crease or fold to be maintained, while the top half of the

skin passes on to the machine and the bottom half passes out. That part of the skin which has been in contact with the top roller and has rolled round the fold is softened, and by reversing the leather the other half of the skin may be treated in the same manner. In some types of boarding machines the leather is drawn over the edge of the table, which tends to coarsen the grain; it is claimed, however, that with the method of operation we have described, superior results are obtained.

Grindery and Repairing Machinery.

A large number of firms showed grindery, small auxiliary tools, and other workshop appliances. Perhaps the most important exhibit of this class of exhibits was that of the British United Shoe Machinery Company, Limited, Union Works, Leicester. This company is said to be in a position to supply anything, from a tack to a full factory equipment, from its various departments and factories.

An interesting section on its stand was set apart for press knives, such as are used with hand and power presses in the leather, cardboard and paper trades. Considerable improvements have taken place in the design and manufacture of such knives, and there are now few difficulties in making a knife of the most complicated form. A series of press knives are shown in illustration Fig. 2. They are formed

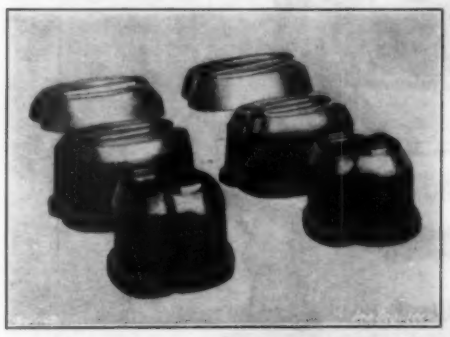


FIG. 2—PRESS KNIVES

of special section strip steel, which is thickened behind the cutting edge where strength is required. By using strip of this section a saving of about 40 per cent. in weight is obtained. The knife is bent to shape round a template, and the ends welded by hand forging or electric welding. The majority of the knives are electrically welded. Those shown in the foreground of the illustration are made with safety bands of ⅜in. by ¼in. steel riveted around the top. This band of steel serves to prevent the fingers of the operator overlapping the top of the knife when it is under the press, since it is quite natural to grip the knife below the band.

Several firms showed exhibits of repairing machinery, the chief of which were Whitfield, Hodgsons and Brough, Limited, Kettering; the Standard Engineering Company, Limited, Leicester; W. B. Hill, Limited, Leicester; and Keats and Bexon, of Stafford. An outstanding example was a complete machine, comprising three finishing machines and a stitcher. The various machines were attached to a strong tubular bed supported on three cast iron A stands, with the power drive below. The equipment included an extractor for removing the dust made by the scouring and polishing wheels and the edge cutters and finishers. Machines of this kind are freely used for repair work in large establishments. Smith and Grace and the Screw Boss Pulley Company, Limited, of Thrapston, showed a complete range of the firm's specialities for the transmission of power, and some large roller bearings for shafts were displayed on the stand of the Northampton Machinery Company, Limited.

Literature.

Friction. By T. E. Stanton. London: Longmans, Green and Co. Price 12s. 6d. net.

Although our knowledge regarding the phenomenon of friction is still very far from being complete, it is undoubtedly the fact that within recent years it has been extended to a remarkably great degree. So much is this the case that we may now reasonably regard all manifestations of friction as providing matter for one connected study and not, as was the case until quite a short time ago, for separate treatment under various headings and at different times. Dr. Stanton, by virtue of his own work on the subject and that of his colleagues at the National Physical Laboratory, is amply qualified to expound the nature and laws of friction on this enlarged basis. Taking the view that friction in all its manifestations is essentially a molecular phenomenon, he has in this volume sought to supply a detailed statement and discussion of it such as previously was not to be found except separately in treatises on general physics, hydraulics, aerodynamics, naval architecture, and machine design.

The manner in which Dr. Stanton treats his subject may best be conveyed by briefly noting the contents of the seven chapters into which his book is divided. In the first chapter the internal friction or viscosity of fluids is discussed. It is shown that the shearing stresses set up in a fluid by relative motion of its parts are responsible for the resistance to motion of the solid surfaces between which the fluid is retained. The viscosity of a fluid, it is held, with Osborne Reynolds, is of two kinds, one being a physical property of the fluid itself and the other being dependent upon its velocity and the form of the solid surfaces constituting the boundaries. The treatment is very extensively mathematical, but good though brief accounts are given of some modern methods for the experimental determination of the viscosity of gases and liquids. The second chapter deals with the external friction of fluids or, in other words, the nature of the motion of fluids flowing over solid surfaces and the resistance to motion experienced by a body moving through a fluid. In this chapter, the longest one in the book, accounts are given of Reynolds' investigations on the flow of liquids through tubes and of Rayleigh's treatment of the principle of dynamical similarity and the experimental confirmation of it which has recently been sought. The chapter also includes a discussion of the results obtained by Froude and others since his time regarding the resistance experienced by thin plates moving through fluids. The friction of the tides and the friction of the wind on the earth's surface are also dealt with briefly and by way of illustration.

In the third chapter Dr. Stanton takes up the question of fluid friction on lubricated surfaces; that is to say, those cases of lubrication in which the phenomena manifested are capable of explanation in accordance with hydrodynamical laws. Starting with a brief account of Tower's experiments, the author devotes some attention to Reynolds' analysis of the results, but on the grounds that Reynolds' methods of attacking the problem have now been superseded he reproduces Sommerfeld's treatment of the half bearing in considerable mathematical detail. Harrison's theory of the complete cylindrical bearing, Michell's theory for flat inclined surfaces and a summary of the results obtained with cylindrical bearings at the National Physical Laboratory—the latter already familiar by reason of Dr. Stanton's presentation of them last year before the Institution of Mechanical Engineers—are also included in this chapter. In the fourth chapter "boundary" lubrication is discussed. The ground covered is sufficiently indicated by stating that it comprises an account of Hardy's and Deeley's researches and of the research conducted by Mr. J. H. Hyde with the Lanchester worm gear efficiency apparatus at the National Physical Laboratory.

Solid friction is dealt with in the fifth chapter. It is interesting to notice that most, if not all, the instances commonly used by the text-books as illustrations of solid friction have now to be regarded as examples of boundary lubrication. The subject of static and kinetic friction between dry solid surfaces is indeed very briefly dealt with, so much so that this chapter only attains reasonable length by virtue of the inclusion in it of examples illustrating the application of the theory of static friction to brick and earthwork structures. In the sixth chapter rolling friction is discussed. Reynolds' theory is summarised with the object of showing that the resistance to the motion of wheels and rollers over a smooth plane cannot be satisfactorily accounted for by supposing it to be due to inaccuracies of the surfaces, but is to be ascribed to slipping consequent upon their deformation. The remainder of the chapter is devoted to a summary of Professor Goodman's well-known paper on the design of ball bearings. A brief chapter on friction and heat transmission concludes the work. Here again Osborne Reynolds' name figures prominently in the theoretical treatment of the subject, while on the practical side experiments conducted by Dr. Stanton in 1895 and by Pannell in 1912 are referred to.

It will be gathered that Dr. Stanton's work covers a large amount of ground of very varied interest. His effort has been to avoid the empiricism by which the subject of friction has been so extensively characterised in the past and to place it on a sound theoretical basis. He seems to us to have conceived his task as beginning and ending with the bringing together, inside the one pair of covers, of old and new theories regarding the various manifestations of friction and with giving accounts of the experimental investigations undertaken with the object of confirming or disproving them. We should have been glad to see something more attempted. However clear a view Dr. Stanton himself may possess of the connections between the various manifestations of friction, the average reader of his book will, we think, lose all or nearly all sense of a common foundation in the course of his study of the details presented in each chapter. Perhaps it is as yet asking too much of anyone to present us with a general review of the phenomena of friction, in all its bearings, in a form that would permit us to see the fundamental features of the subject without being confused by the details of theories and experiments. While it is agreed that friction of all sorts is directly dependent upon the molecular constitution of matter, knowledge concerning the exact manner of its dependence is still largely to be acquired. We are, in fact, only just beginning to discover the relationship, as, for example, by Mr. Hardy's establishment of the connection between coefficients of friction and molecular weights under the condition of boundary lubrication. Nevertheless, even with our present imperfect knowledge any attempt which Dr. Stanton might have made to give us a general outline of the common fundamentals of frictional manifestations would have been very welcome.

The Properties of Engineering Materials. By W. C. Popplewell and H. Carrington. London: Methuen and Co., Limited. Price 25s. net.

This volume, designed for practising engineers and senior students, contains 538 pages, of which 268 are devoted to a discussion of the mathematical relationships between load, stress and strain, and the remainder to an account of the general properties of engineering materials, the mode of their manufacture, and the method of their testing. Its title is thus, to a certain extent, misleading, for, strictly speaking, it applies only to the second half of the book, the subjects dealt with in the first being generally regarded as falling under the heading of applied mechanics or the theory of structures.

The authors, in their preface, acknowledge that excellent books on the strength of materials already exist, but they add that "it was felt that there was room for one more dealing with the subject from the descriptive as well as the mathematical standpoint." Exactly what they mean by that phrase we are at some little loss to say. It seems a poor excuse for adding yet another book to an already overcrowded catalogue of works on this subject. Certain it is that, in the authors' treatment of their matter, we can find little to distinguish it from a host of other works covering the same ground.

The authors have found it impossible to make the book, in spite of its size, complete or up to date. The chapter on repeated and reversed stresses, for instance, extends to less than ten complete pages. It contains no mention at all of the important work recently carried out on this subject by Haigh, Gough, Stromeyer, and others. In fact, we can find no reference to any research results obtained since 1914. In the chapter on hardness—a subject discussed in six and a-half pages—recent investigations and appliances are also quite neglected. We miss, too, reference to the work of Meyer, Ludwik, Batson, and others. Why a description of the Izod impact test should be included in this chapter is not clear.

In its details the book is not free from inaccurate and misleading statements. Stress is defined as the resistance offered by a material to deformation, thereby implying that stress is an intrinsic property of the material. Again, it is stated that within the elastic limit the stress is directly proportional to the strain, all reference to the limit of proportionality and the fact that it is not necessarily coincident with the elastic limit, being omitted. It is true, of course, that for most practical purposes the two limits may be regarded as occurring at the same point, but scientifically the fact that they are separated at times by a distinct interval seems to be of considerable significance, and ought certainly to have been mentioned in a scientific treatise. In summarising the different kinds of deformation under load of importance to engineers, the authors have quite forgotten to mention the case of columns. Dealing with the Brinell test, they state that the area of the indentation is to be measured by means of the diameter of the impression, and in a diagram it is clearly shown that that diameter is to be taken at the top of the ridge thrown up by the ball. It has been definitely established by experiment that comparable hardness figures with the Brinell test can only be obtained by calculating the area of the indentation from a measurement of the depth of the impression neglecting the ridge effect. Here, again, it is true that for workshop purposes it is generally held to be more convenient to use the diameter rather than the depth of the impression as the basis for calculating the area of the indentation. But in a scientific work we are surely entitled to expect emphasis laid at least as much on the scientific as on the practical aspect, and not, as in this case, solely on the practical.

In spite of some shortcomings, the book will, no doubt, find readers, and, if read with discretion, it will, in many places, be found useful. It is not, however, a book that we can recommend to a science student working without the guidance of a teacher.

SHORT NOTICES.

Automatic Telephone Systems. By William Aitken. London: Benn Bros. Price 35s.—This volume constitutes the second part of the author's book on automatic telephone systems. It is an extensive publication, containing many diagrams, and its preparation has obviously involved a great amount of work. A third volume is also to be published, and when the complete work is finished it will, we believe, be by far the most complete work of its kind. The subject is, of course, a very complicated one, but the diagrams given in the book will, we think, readily be followed by those who are associated with telephone work. At any rate, they appear to us to be about as simple as it is possible to make such diagrams. The present volume is concerned mainly with the equipment at the offices of subscribers connected to automatic exchanges and with private and small public branch automatic exchanges.

Railway Matters.

We regret to hear of the death of Mr. W. G. Boonzaier, the inventor of the automatic coupling, described in The Engineer of March 18th, 1921.

There was a collision at Boston Station, London and North-Eastern Railway, on Friday evening last. An arriving passenger train was run into, head on, by a light engine. The driver of the incoming train was badly hurt.

According to the newspaper reports, an electric railway linking the north and south parts of the island, is to be constructed in Madeira. The total length of the line will be 70 miles. A port of refuge is also to be constructed at Funchal. The estimated cost is about £1,000,000.

The Priory Station at Dover has long been considered antiquated and in need of remodelling. The Dover Corporation wishes to improve the adjoining Folkestone-road, and Sir Herbert Walker and other chief officers of the Southern Railway visited Dover one day last week to discuss the plans.

Four new trains have recently been put into service on the Tilbury section of the London, Midland and Scottish Railway. They have been built at the company's works at Derby, and each consists of eleven coaches, has a total length of 623ft., and weighs 275 tons. They are of the exceptional width of 9ft. over the mouldings so as to seat "six aside" in the third-class compartments.

The Institution of Railway Signal Engineers now issues its "Proceedings" twice yearly. Part I., for February to July of the present year, has just been issued, and is of particular interest, because of two papers—"Railway Accidents," by Mr. G. Holt, and "The Theory of Interlocking," by Mr. J. S. Moore—which are accompanied by useful tables and diagrams. Copies of the "Proceedings" at 7s. 6d. may be obtained from the Hon. Secretary, Mr. M. G. Tweedie, 80, Caversham-road, Reading.

A deputation waited upon the board of the Great Western Railway Company on the 16th inst., to discuss the proposed bridge over the Severn at Beachley. It is understood that the result was an agreement that the bridge should be for vehicular as well as railway purposes, and that its design and, if sanctioned, construction should be undertaken by the railway company. Mr. Forestier Walker, M.P., and Mr. W. W. Grierson, the engineer-in-chief to the Great Western, were appointed to wait upon the Ministry of Transport.

The Central Wages Board was, on the 10th inst., unable to agree as to the railway companies' proposals for modifications in the terms and conditions of service and the counter proposals of the Associated Society of Locomotive Engineers and Firemen. These proposals will now go to the National Wages Board, presided over by Sir William Mackenzie, on which, in addition to six representatives of the companies and six of the men's unions, there are representatives of the Trades Union General Council, the Co-operative Union, the Association of British Chambers of Commerce, and of the Federation of British Industries.

The electric train service of the London, Midland and Scottish Company between Addison-road and Willesden, High Level, is to be improved by the provision of a bay line on the down, or south, side of the latter station. As this provision is being made to avoid interference with the Broad-street Richmond service, we assume that the junction for the new bay will be laid in on the Earl's Court side of the junction with the North and South-Western junction lines. The new road will allow the Earl's Court train to be reversed without having to go through the station to the sidings near Harrow-road-over bridge, and then shunt back on to the down line.

The programme offered by the Great Western Railway Company as its contribution towards finding relief for unemployment was thus summed up by Sir Mantague Barlow, the Minister of Labour, in a speech he made on the 16th inst.:—As to the efforts made by the great railways and other private companies, the programme of the Great Western Railway was an excellent example. New works to the value of £4,500,000 were being authorised and of them, works to the value of £1,000,000 were to be proceeded with at once. A sum of £2,500,000 was to be spent on new locomotives and rolling stock. Maintenance work and renewals were being expedited. For instance, the company was ordering 34,000 tons of steel rails at once. On the provision of new steamers £250,000 was to be spent at once, and in anticipating orders for stores £1,000,000 would be spent.

On May 12th one of the worst tramway accidents of its kind occurred to a Leeds Corporation tramcar, which got out of control when descending a 1 in 15 gradient, and ran thus for 730 yards, until it was derailed and overturned, causing the death of seven passengers. Lieut.-Colonel Mount held an inquiry on behalf of the Ministry of Transport, and his report thereon was issued on Monday. Briefly, his conclusions are that the motorman lost his nerve. He was gassed during the war and six months later wounded in the left forearm. The man told Colonel Mount that he could not make brake applications to the extent other motormen did, and that his arm certainly was not so strong as it was before the war. The near-side track magnet was apparently out of action at the time of the accident, and the additional pressure created by the magnetic track brake would thereby only be applied to one pair of the mechanical shoes instead of to both pairs. The magnet shoes were considerably worn, and required early renewal. Tests were made with the platform gear to see if the gear slipped out of mesh, but this did not happen. In the effort to do this, however, the ratchet in the hand brake handle slipped, and it was found that the ratchet gear showed a good deal of wear. Such failures are very infrequent; at Leeds only six have had to be replaced for wear in twelve months. Not only the motorman, but a conductor riding as a passenger lost their heads, and the report says that "their failure may be partially attributable to forgetting what they had been taught." Colonel Mount says about the conductor that he "had not the experience to deal with an emergency of this nature, and so far as it is practicable, only conductors of longer service should, I think, be permitted to work on the more difficult routes."

Notes and Memoranda.

It is reported from Stockholm that a new iron alloy has been invented by the Aktiebolaget Ferrolegeringar, of Trollhaettan. The new iron, which is said to possess all the qualities of ordinary soft iron but does not rust, is manufactured from Swedish iron ore mixed with ore imported from South Africa.

A copy of the amended rules for the grant of mineral licences and mining leases in British India, which were published as a supplement to the *Indian Trade Journal* of September 27th last, may be consulted by United Kingdom firms interested on application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

After considering several new schemes, including cork paving blocks, bricks made of waste glass subjected to a heavy pressure, and a combination of iron and concrete, the Bradford Corporation has decided, according to the *Ironmonger*, to lay down, as an experiment, a rubber surface to one of its principal highways. The city engineer has, for this purpose, accumulated large stocks of old motor tires, from which rubber paving blocks are being made.

A memorandum has been prepared for the Safety in Mines Research Board to place on record the information that is at present available regarding the application of incombustible dusts in coal mines as a precaution against coal dust explosions. In it have been collated the more important facts and expressions of opinion that have been published since the use of incombustible dusts became general. The memorandum, which is entitled "The Application of Stone Dust in Coal Mines," may be purchased, price 1s. (by post 1s. 1d.), from any bookseller, or directly from H.M. Stationery Office.

Discussing the use of conveyors in the workings of coal mines at a meeting of the Mining Institute of Scotland, Mr. W. G. Burt said that the seams which were suitable for conveyors were: (1) Any seam with a fairly good roof; (2) seams where the coal was soft and friable; (3) seams which were hard and were worked by coal-cutting machines. Many different types of conveyors were on the market, some of which were very good, while others were practically useless. Three very good conveyors of the constant delivery type were (*a*) the Blackett, (*b*) the shaker or jigger, and (*c*) the belt conveyor. Conveyors of the intermittent delivery type were (1) the Thomson, (2) the Eyecock, and (3) the McDonald. Mr. Burt gave details of the working costs and conditions of some of these types of conveyors.

In dealing with the results of the great earthquake in Japan, Sir E. Crowe says that a considerable amount of machinery was damaged in the textile mills in the neighbourhood of Tokio and Yokohama. Nearly 500,000 cotton spindles were destroyed and about 400,000 were temporarily put out of action. The large waste silk mill of the Fuji Gas Company near Yokohama, which was the largest mill of its kind in the world, was destroyed, while a large proportion of the woollen and worsted mills in the Tokio district are said to have been damaged. One of the most important lines in which business can be developed is that of structural steel, but it is probable that the first phases of reconstruction work will be of a temporary nature and will consist of wooden buildings. As regards metals, there will naturally be severe competition both from America and Belgium. There will, no doubt, be a demand for various types of fire-fighting appliances.

Speaking at the Swedish Hall, Harcourt-street, Marylebone, on October 17th, Mr. E. G. Sahlin, the Swedish Consul-General, said that in 1780 Sweden's output of pig iron was the largest in the world; but in 1913 it had shrunk to 1 per cent. Swedish iron was still pre-eminent in quality, but the shrinkage quoted was due to the increase of coke-smelted pig iron made possible by the introduction into Great Britain of the puddling process. Owing to the high quality of the Swedish ore, and the high cost of charcoal, it did not pay to use the Swedish mild steel for structural work. Whilst Sweden sent 100,000 tons of pig iron and 200,000 tons of iron and steel to Great Britain annually, she bought about 120,000 tons of various products from the English rolling mills and blast-furnaces. British capital had been foremost in opening up the important Swedish iron ore deposits. Amongst Swedish engineers who had come to England were Thorsten Nordenfelt, Kristian Petter Sundberg, and John Ericsson, the constructor of the battleship Monitor. In 1829, when Robert Stephenson's Rocket proved victorious, Ericsson's engine missed success through an accident.

The electrical aspect of nitrogen fixation on an industrial scale is an important one, because the electrical energy utilised varies so greatly with the process employed. A French writer, P. Bunet, states the *Electrical Review*, discusses in turn the several methods and estimates the amount of energy required for each, and the possibilities of initiating some process on a large scale in order to utilise the residual energy from hydro-electric stations and large plants generally. Of course, with modern processes of nitrogen fixation, electricity only plays a secondary part, although large quantities are necessary for power purposes in the Haber and Claude processes, and in the more recent process of Casale, an Italian chemist—in which the pressures employed are midway between those used in the other two processes. It has been suggested that the hydrogen required for these processes could be easily obtained as a by-product in the electrolysis of sea water, and by simply electrolysing water. The former of these two methods is already in use on a small scale, though it was fairly extensively used for aeronautical purposes during the war. The writer estimates that a 10,000-kilowatt station supplying an electric railway, where the demand for energy is 120,000 kilowatt-hours a day, or, say, 5000 kilowatts mean power, subject to fluctuations, could supply 7.5 tons of fixed ammonia per day, or, say, 6 tons of nitrogen. Thus an appreciable income could be achieved after making allowance for the cost of installation. With the hydrogen obtained cheaply by the electrolysis of saline solutions in this way, the process of producing the fixed nitrogen, and, finally, nitrates, could be considerably cheapened.

Miscellanea.

The gasworks at Marple are to be extended at a cost of £43,000.

Work has been started on a bore-hole at Seaham Harbour in connection with the mining of the undersea coal.

Last year the South African Government's share of the profits of the gold mines amounted to some £10,000,000 sterling.

It is said that the annual importation of cast steel axle-boxes into India amounts to 40,000 pieces at a price of about £2 each.

A powerful steam ferry of the double-ended type has been ordered in this country for vehicular traffic at Sydney, Australia.

The plant of the Brakpan gold mine, South Africa, is to be extended, at a cost of, approximately, £40,000, so as to raise the capacity to 80,000 tons a month.

The water turbines which are being built in England for the extension of the power plant at Winnipeg, Canada, will have an output of 7500 horse-power each, and will work under a head of 45ft.

The report of the Oxygen Research Committee, which has just been issued and can be purchased from H.M. Stationery Office, price 8s. 6d., deals almost exclusively with the double-walled metal vacuum flask for the carriage of liquid oxygen with a minimum of loss.

On October 24th, Sir George Lloyd, Governor of Bombay, inaugurated the Sukkur irrigation scheme, when, in the presence of a large gathering of officials and prominent Zemindars of Sind, he laid the foundation of what is to be known as the Lloyd Barrage at Sukkur.

The Polish Ministry of Public Works has completed a scheme for the construction of a canal which will link the mining basin of Upper Silesia with the Baltic Sea. A special extension will connect the Upper Silesian Basin with Warsaw *viâ* the rivers Warta and Vistula.

It is reported from Rome that Signor Mussolini has approved the plan for the improvement of the Monza motor track, which, it is hoped, will become a model track and be of service, not only to Italian manufacturers, but also to the motor industries of the whole of Europe.

The Glasgow Corporation has approved of a recommendation that the Gas Committee shall erect a five-unit battery of Maclaurin producers at Dalmarnock to make smokeless fuel, and supply gas to the Electricity Department to fire boilers. The Electricity Committee has agreed to buy the gas at a price not exceeding 1d. per therm.

A scheme for the disposal of storm water in Bengal, which is said to have been recommended by the local Government, will cost, approximately, 35 lakhs of rupees. It is proposed to construct a large reservoir near Dhappa, and to dredge out the silt which it will accumulate annually. The dredgings will be used for reclaiming low-lying land.

It is reported from Bombay that a wireless telegraph company, formed for the purpose of erecting a high-power wireless station in India, has been registered under the name of the Indian Radio Telegraph Company, Limited. The capital of the company is given as being three crores of rupees, and the directors include Sir Purshotamdas Thakurdas and Sir Ibrahim Rahimtoola.

It is announced in the *Iron and Coal Trades Review* that the workings of the old Towercroft pits, in the Bothkennar district of Grangemouth, which have been flooded for years, are being unwatered. There is a large area of coal to work, and hopes are entertained of employment being provided for 600 men. Another old colliery is being reopened at Gartshore, near Kilsyth, where the recent explosion of fire-damp occurred.

What is probably the largest blast-furnace in the North-East Coast district has, according to the *Ironmonger*, been completed at the Clarence Ironworks, near Middlesbrough. It will be put into operation in the near future in substitution for one now in blast. The new furnace will have a capacity of from 2000 to 2500 tons per week; it is 80ft. in height, with a bosh 21ft. 6in. in diameter, and a hearth 13ft. in diameter. Its equipment includes an automatic charger, electrical handling apparatus for dealing with materials, and a turbo-blower.

In order to encourage the manufacture of carbon black the Canadian Dominion Government has authorised its production from the surplus quantities of natural gas obtained from isolated fields held under lease for the production of gas. Permits so to use the gas will, however, only be granted where there is no market for the sale of the gas. The lessee must construct a plant at a cost of 30,000 dollars within two years, capable of producing 90 tons of carbon black per annum, and must pay a royalty of 5 per cent. of the value of the gas at the point of production.

On Wednesday last, before the "United Wards Club" of the City of London, Mr. W. J. Liberty, of the engineer's office, Guildhall, London, gave, at the Cannon-street Hotel, an illustrated lecture entitled "Underground London," dealing with its hidden rivers, springs, spas and wells, sewers, subways, first steam railways, electric tube railways, early and modern Roman baths, caves, remains, bakehouses, restaurants, wine vaults, mains and pipes, obstructions. The whole was illustrated by about ninety lantern slides, and dealt with underground constructional works. The hall was filled to overflowing. A discussion followed the lecture.

The question of deepening the Flintrännan passage in the Oeresund in order to enable large steamers to pass through this channel from the Baltic into the North Sea on the Swedish side of the Oeresund, is again being discussed, according to the *Iron and Coal Trades Review*. The Swedish Minister for Communications has declared that the Government is taking a lively interest in the scheme, which is intimately connected with the construction of a deep-water port on the south coast of Sweden. It was originally estimated that the cost of deepening the Flintrännan passage would be Kr. 100,000,000 (£5,560,000), but it is now hoped that the work could be carried out for much less.

MACHINERY EXHIBITS AT THE SHOE AND LEATHER FAIR.

(*For description see page 449*)

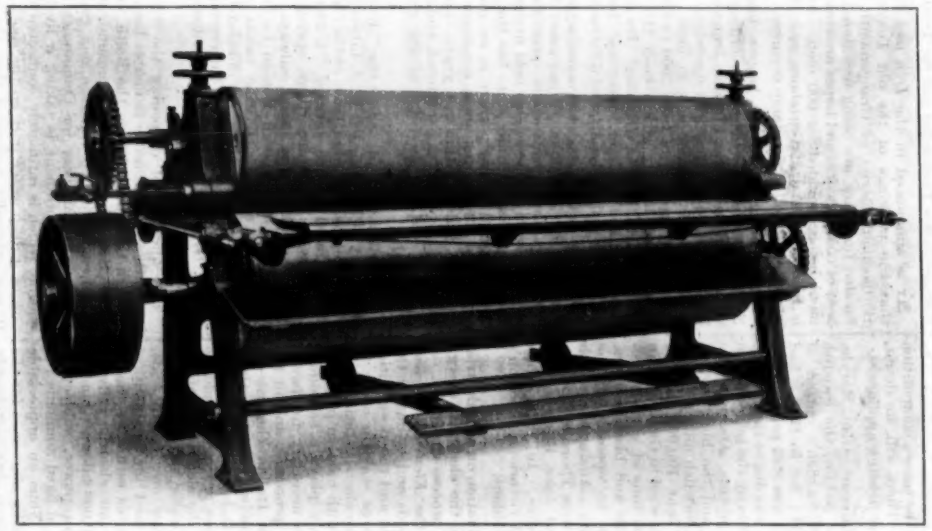


FIG. 3—TURNER BOARDING AND SOFTENING MACHINE

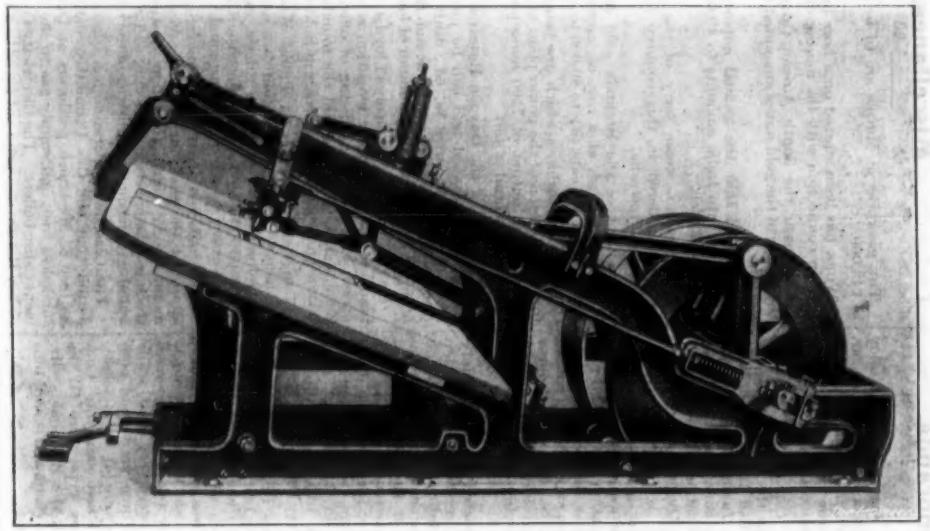


FIG. 4—TURNER CLAMP STAKING MACHINE

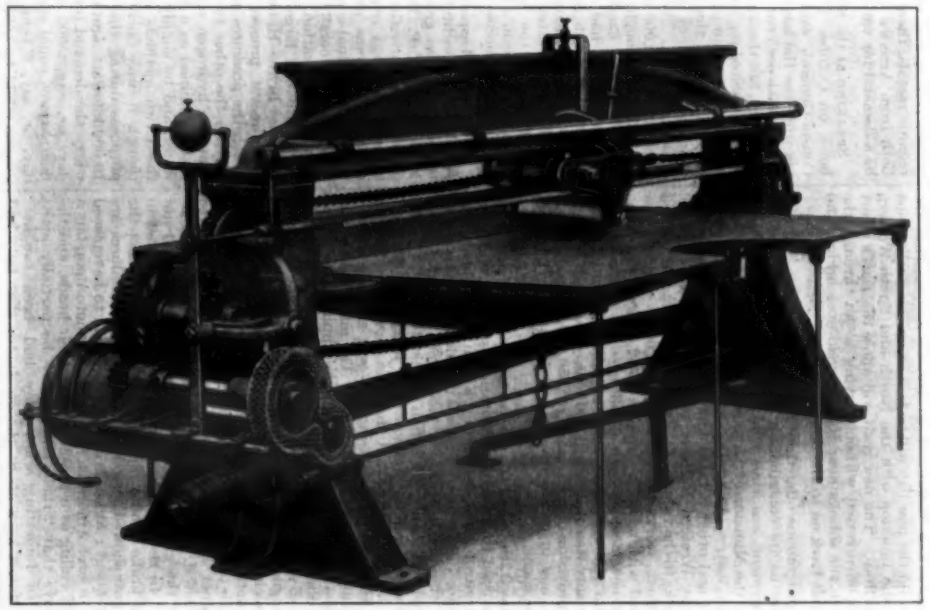


FIG. 5—WILSON TWIN-BED LEATHER ROLLING MACHINE

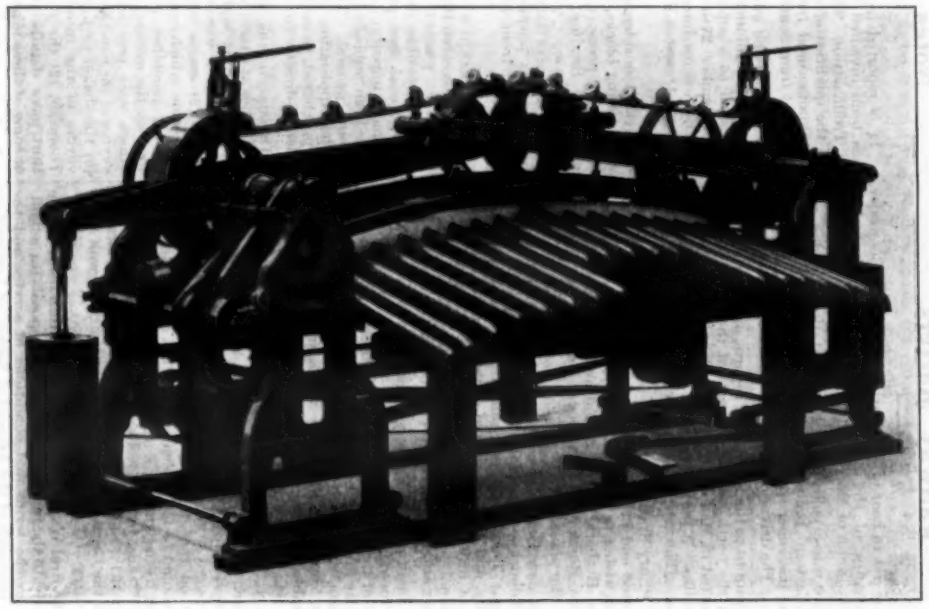


FIG 6—WILSON DOUBLE-BAND SCOURING MACHINE

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THE ENGINEER.

OCTOBER 26, 1923.

Patents for Inventions.

It is alleged that, for some time past, the Comptroller has been exceeding his jurisdiction by refusing the grant of patents on the ground that the specification does not reveal any "manner of new manufacture" within the meaning of those words as used in the Statute of Monopolies upon which our patent laws are founded; or, alternatively, that the specification shows a "want of subject matter." The Chartered Institute of Patent Agents is, we understand, taking the matter up and proposes to put pressure upon the Board of Trade to remove this alleged new practice. The contention seems to be that it is not the business of the examiners at his Majesty's Patent Office to consider either of the grounds of rejection indicated above. It is held that if the examiners can find no anticipating British patent and if the invention is fairly described, then the question of whether the invention is or is not "a new manner of manufacture" and the question of "subject matter" should be left to the decision of the law officers if the validity of the patent be challenged. This attitude is adopted because it is held that since it is well nigh impossible to say from a specification alone what may or may not prove ultimately to be valuable—apparently trifling improvements having occasionally proved of first-rate importance—the widest view should be taken both of novelty and of subject matter. In other words, it would almost seem to be the wish of those who oppose any extension of the power of the Comptroller that patents for inventions should be sold across the counter like postage stamps! We shall give our reasons for opposing this view and for supporting the Comptroller in what is alleged to be a recent extension of his jurisdiction.

All monopolies are bad in principle, but they are, in certain conditions, expedient. It is said that inventors would not invent and manufacturers would not prosecute new developments were there no protection. The truth of that statement cannot be checked. That it was true when the Statute of Monopolies was passed cannot be doubted; that it is equally true now is open to some question. Methods of manufacture have changed the conditions materially, and the possession of capital is frequently more important than the possession of patents. Sir John Dewrance, whose experience extends over a large range, stated in his presidential address to the Institution of Mechanical Engineers on Friday last—see page 445—that "patents have gradually become of less importance in mechanical engineering than they used to be." . . . "Thousands of costly new designs are exploited without the assistance of the temporary monopoly." A still more illustrious engineer, Lord Armstrong, said, in his presidential address to the British Association, as long ago as 1863, that "The seeds of invention exist, as it were, in the air, ready to germinate whenever suitable conditions arose, and no legislative interference is needed to ensure their growth in proper season." If, on the one hand, we admit that there is some measure of truth in this common belief that without the protection of patents invention would be checked, we are constrained to acknowledge, on the other hand, that the possession of patent rights, not by any means infrequently, arrests the extension of industries. Had Watt not held his patent of 1769, a score of firms would in his day have built steam engines for every one that did so. Had Trevithick been more careful in the protection of his inventions the progress of the high-pressure engine would have been much slower than it was. Does anyone suppose that electrical engineering would have advanced more rapidly than it has done had Faraday patented his discoveries? With such doubts as are raised by these examples before us we must not too hastily assume that patents for inventions are essential to progress. There are indeed no good grounds for believing that the world would be "one penny the worse" if the examiners in the exercise of their duties materially reduced the number of patents. But in any case patents are monopolies, and the granting of monopolies without control is repugnant to all thinking men. Some control there must be; the question is how much. The patent agents wish to see the control minimised; for our part we should be glad to see it strengthened. Loose control leads inevitably to abuses. The intention of the patent laws of all countries is to encourage the industries of those countries. They are too often regarded as a means of rewarding the inventor rather than the nation. A patentee never considers the country's good; he thinks only of his own. The result is that a great many blocking patents are taken out annually by wealthy firms and individuals. They are patents which have been aptly described as "keep-off-the-grass" patents. There are others which might be described as "sporting-chance" patents. An idea occurs to someone, he hurries off to a patent agent, makes a rough sketch on the blotting pad, and secures a patent for it. He may or may not go further with it; but in any case he is in a position to stop anyone else having it without his consent. We do not hesitate to say that many hundreds, possibly thousands, of such patents are applied for annually in Great Britain alone. They do the country no good. There is no return value for the monopoly granted. Furthermore, such patents may do substantial harm by appearing as anticipations of some genuine invention. Then we have hundreds, possibly thousands, of patents granted—simply on the grounds that within the past fifty years there is no anticipatory patent in his Majesty's Patent Office—for devices which should not be patentable at all. Rarely a week passes that in our abstracts a case of the kind may not be found. We may recall an ancient but classical example. An individual claimed protection for the increase of the width of the blank margin between two pages of type in newspapers. The Comptroller refused the grant; the case came before the law officers, and they held that since the matter had not previously been patented the applicant's claim must be upheld! It is said that no one suffers by such grants. We cannot accept that view. In the first place, the Patent Office has taken a fee for what it knows either to be valueless or to be capable of improper use. Whilst it knows that the patent may be safely ignored, it knows also that as likely as not, rather than face the expense and worry of a legal action, someone may purchase it. In any case the country is not a penny piece the better for such patents—if we disregard the margin remaining over and above the small proportion of the fees that remains when administration expenses have been deducted. The principle of the patent laws, that the industries of the country should be benefited in exchange for the monopoly granted, is therefore offended by such patents.

Any action, therefore, which checks the grant of protection in such cases as we have been considering is worthy of our support. But it is said that the Comptroller is *ultra vires* in exercising any restriction. Let us see. In May, 1922, a case of much importance in this connection came before the Lord Chief Justice (Lord Hewart), Mr. Justice Avory, and Mr. Justice Shearman. It is known as the King *v.*

the Comptroller-General of Patents (*ex parte* Munts). In his ruling Lord Hewart said: "The complaint is that the Comptroller-General of Patents . . . has taken upon himself the task of deciding whether that which is put forward as an invention is indeed an invention, and it is said that the Statute makes no provision for any such inquiry at that stage, and that, if an applicant declares that he is in possession of an invention, or, of that which he alleges to be an invention, acceptance must follow as a matter of course, subject to certain matters which it is said are provided for by the Statute itself." Continuing, he said: "The whole matter starts with an application which contains a declaration to the effect that the applicant is in possession of an invention, and the argument on the part of the prosecutor here involves this proposition, that although it may well be the duty of the Examiner to report whether the nature of the invention is or is not fairly described, it is not open to him to say that that which is put forward as an invention is not an invention at all. In my opinion, the question whether the alleged invention is an invention in the sense of being some new manner of manufacture is clearly a question which may be reported upon." Mr. Justice Avory and Mr. Justice Shearman concurred, the former saying clearly that "the Comptroller-General has a right to determine whether the application before him is an application for an invention at all." With such a recent and decisive opinion by three eminent judges it would seem absurd for anyone to say that the Comptroller is now exceeding his jurisdiction in refusing the grant of patents for certain alleged inventions.

We find it, we must admit, difficult to comprehend the attitude of those patent agents who are opposed to the alleged new practice of the Examiners. Even on the low ground, which we should be sorry to attribute to them, that any reduction in the number of accepted patents would reduce their incomes, we believe they would be at fault, for the fees that might justly be asked for securing a patent in the face of the jealous examination of its merits by the Patent Office would compensate them for the loss in numbers. Nor are we willing to believe of them that they are content to secure an alleged protection for inventions which they know to be unworthy of protection. The common defence of their attitude is that no one can tell whether an invention is valuable or not till it has been put to the practical test. That is true in some cases, but by no means in all. There are many and many so-called inventions which are obviously not inventions at all and which have been anticipated over and over again, though the records do not appear in the files of the British Patent Office. Of the Examiners and Assistant Examiners, many are well-trained technical men, some graduates of science schools and universities, some Whitworth scholars, many with extensive knowledge of foreign languages and conversant with foreign technology. Such men are quite competent to say at once that an invention is either impracticable, is already in common use, or that it is not a fit subject for protection. We are by no means sure that the few instances which have been adduced do actually prove that these Examiners are exceeding functions hitherto exercised or outside those defined by Lord Hewart; but, for our part, we should rejoice at any steps they took, within the law, to render the grant of patents for frivolous or futile inventions less common than it is. There is, unfortunately, a quite unfounded belief that the number of patents is a measure of the inventiveness of the people. It is nothing of the kind. Many real inventions are never patented, whilst many devices for which under the present conditions patents are granted are not novel inventions at all. The value of the protection given by British patents is already known to be very small; we must deprecate anything that will make it smaller still, and support everything that tends to increase it.

Individuality in Locomotive Engineering.

One of the attractive features brought out by a study of the development of the locomotive is the variation in the practice of different designers, not only in what we may term general characteristics, but also in the matter of the detail parts; in fact, to our mind, locomotive development has benefited in no small measure through the individualism of those who have had practically unhampered control in the practice obtaining at different periods, not only on our own railways, but on those of other countries in a similar economic position to our own.

We have frequently insisted upon the value of the personal factor so far as locomotive designing is concerned, and have always recognised that the accumulated experience thus provided is conducive to the ultimate improvement in the efficiency of the modern locomotive. Up to the end of last year we had in this country several separate and distinct great railway systems, the motive power for which has been constructed under the directions and to meet the views of eminent locomotive engineers, each one of whom, at one period or another, has exercised his own particular ideas as to what constitutes good practice in order to meet successfully any given conditions—conditions in a general way common to most lines, but differing, we admit, in what we may call for the sake of comparison a detail sense. In order to illustrate our meaning we may take as an example certain distinctive features introduced by Mr. Churchward during his tenure of office at Swindon, when, to meet the conditions imposed by heavy express services, a boiler of what was then in this country a departure from existing practice, having a tapered barrel and Belpaire fire-box, was introduced; whilst at the same time, to meet similar requirements on the Great Northern, Mr. Ivatt used a boiler having the barrel section of conventional construction with a round-topped fire-box having a wide grate. This combination was at that time also a new feature in express locomotive designing. Then again, in the matter of detail design, Mr. Churchward conceived the idea of simplifying the "big end" of the connecting-rods for his outside cylinder engines, and introduced the solid-end form which has since been characteristic of Swindon-built engines of the kind mentioned. Looking elsewhere, our attention is arrested by the cylinder arrangement adopted by Mr. J. Holden for his experimental Decapod of 1893, and by Mr. J. Manson's four-cylinder engine on the Glasgow and South-Western of 1897. The former engine showed what could be accomplished by the three-cylinder system, and with the fine engines in later years introduced by Sir Vincent Raven has proved one of the most noteworthy milestones in modern locomotive development, for although four-cylinder engines have been used in large numbers, and may be still further developed in the future, the striking success and the general adoption of the three-cylinder arrangement is common knowledge. In the adoption of the superheater, too, we have the individual efforts of Herr von Garbe, of the Prussian State lines, and in this country of Mr. D. E. Marsh, of "The Brighton." These are a few cases involving design, but it is evident that in the matter of materials also many instances indicating the value of the experiments made by individual engineers may be enumerated. We may note, for example, the work done during recent years by Mr. J. T. Wallis, general superintendent of motive power of the Pennsylvania system, to whose efforts the use and the successful adoption of alloy steels for motion parts is very largely due. The individual work done by other notable designers might be cited, and no doubt will be brought to mind by many of our readers; we think, however, enough has been said to show how the distinctive work of engineers, working each on their own particular theories, has developed some particular system or detail of construction, and the statement that such efforts have been conducive to the improvement of the modern locomotive is well illustrated and the truth of our assertions shown by taking as an example Mr. Gresley's splendid "Pacifics;" here we have the three cylinders, the boiler having a coned barrel course and the wide fire-box, the superheater, the alloy steel motion parts, and the solid bush form of "big end," thus incorporating details, the development of which is the outcome of the efforts of engineers, each one of whom, while working on the solution of similar problems, contributed some one or other improvement in construction, which, when added together, go to make up the modern locomotive as we know it at the present day.

Nothing, we think, could more clearly indicate the value of independent designing and the great value that it has been in the past as a factor in the development of the steam locomotive. In the future, so far as our railways are concerned, we can hardly expect to see the same diversity of opinions expressed by the appearance of successive locomotive designs. We have, however, sufficient confidence in the abilities of the chief executive officers of the mechanical departments of our four railway groups to express the opinion that progress in development is not likely to suffer, and we express the hope that, although the principles of design and of broad policy may be dictated—and rightly so—from headquarters, the individual efforts and ideas of the chief divisional officers may be allowed that amount of freedom which, we think, will not only be of value from what we may term a "territorial" standpoint, but will, as in times past, be of inestimable value as providing in a measure the wherewithal with which we are to build the steam locomotives of the future.

The Drive Method of Winning Petroleum.

(*By a Contributor.*)

Of all the different forms of waste which are prevalent in the petroleum industry, and of which we are being constantly reminded by writers on the subject, there is none comparable with the waste in failing to extract the greater part of the petroleum from an oil-bearing sand when it has once been located.

One of the greatest authorities of the United States on oil recovery methods, J. O. Lewis—see Bulletin 148, United States Bureau of Mines—is of opinion, from an extensive investigation of the subject, that only from 10 to 20 per cent. of the oil in a petroleum bed ever reaches the surface by the ordinary drilling methods. Other authorities have put the percentage recovered somewhat higher, but all agree that the oil left in the oil-bearing bed is equal to, or more than, that which is actually recovered. Lewis gives very convincing reasons for his estimate, and there seems reason to think that the average recovery is certainly not more than the 20 per cent. maximum given by Lewis, or, say, a fifth of the whole. But even if it amounts to a quarter, or a third, the loss by the failure to recover the balance is appalling.

The vital part which this essential commodity plays in modern civilisation makes it worth while carefully to examine any suggestion for adding to its available resources, and furnishes the excuse for this article.

Sand containing petroleum can be regarded as an oil reservoir consisting of the spaces between the solid particles. These spaces are generally referred to as "pore space" or "pore volume." The pore space varies in different sands and ranges from about 10 to 33 per cent. This is supposed to be occupied by oil in an untapped oil bed, and to calculate the quantity of oil contained in a given bed is not difficult if the area, average thickness, and the average pore space are known. If, from the quantity of oil thus calculated, the actual quantity of oil produced up to the time the field ceases to produce is known, the percentage of extraction can be stated.

Even in sands containing pores relatively large, it is a well-known fact that the oil can only be forced out of them to reach a bore-hole at an appreciable distance by a propelling agency, which is almost invariably the gas which accompanies the oil, sometimes assisted by water. Different oil beds yield different proportions of the oil they contain to the pump, depending upon the degree of the gas pressure, the viscosity of the oil, and the friction and capillary attraction offered by the sand pores. Gas, then, is the chief medium for expelling oil from their containing sands, and thus, when we speak of an exhausted oil well or field, it is not the oil which is exhausted, but the driving force of the gas.

Naturally, the large discrepancy between recovery and the actual oil existing in an oil bed has received considerable attention, and efforts have been made here and there to increase the recovery. These efforts have taken the forms of (1) vacuum pumps, which, by creating a partial vacuum around the bottom of the well, tend to attract the oil into the vacuum created. This method has been only moderately successful, and some authorities maintain that while it increases the oil flow for a time, it does not add to the quantity ultimately obtained from the sand. (2) A more successful method is the forcing of compressed air down certain prepared wells, and pumping from other wells not far away. This method is beset with many difficulties, including the by-passing of air, which is the passage of the air through channels of least resistance leaving large portions of the oil-saturated sand unaffected, and also the tendency to leakage through old wells which have not been perfectly plugged. As a rule, the oil recovery is increased by this method, but the increase is not always sufficient to recoup the extra cost of the necessary plant and preparations. (3) In exceptional cases, where the oil sand is dry, and there is a water-carrying bed above it ordinarily sealed off from the oil bed, the seal is broken by one or two wells strategetically placed, and the water from the upper bed allowed gradually to flood the oil bed below. This water has the effect of driving the oil to wells at a little distance away and thus increases the yield from these wells until the water reaches them, when they have to be abandoned. This method is pursued with considerable success on the Bradford field in Pennsylvania, but it is not known to be used with the same success in other fields. Obviously, it depends for its success on certain conditions which are absent from many fields. In all of these methods the gain

in ultimate production from a given well or field, is small compared to the quantity of oil left in the sands, and, therefore, they leave the problem of recovering a high percentage of the oil in a field still unsolved. The situation evidently calls for a far more drastic method, and this appears to be provided by applying ordinary mining methods to the recovery of petroleum, that is, recovering the oil by shafts and drives. This method will now be briefly considered.

The shaft-tunnel method of winning oil is not new. This method preceded boring, more or less, and was practised at Pechelbronn, in Alsace, for over a century, although, in this case, it was more for a thick grease known as "graise d'asphalte" than for liquid oil.

The first efforts to obtain liquid petroleum at Pechelbronn by means of underground workings was made in 1866, but only in a small way. Owing to insufficient ventilation, and inefficient methods of working generally, accidents were frequent, and when a light oil was struck in a lower bed in 1892, the method was abandoned in favour of production by drilling, and this drilling method was continued until the war. In 1916, the Germans being then in desperate need of petroleum, the idea of increasing the output of the Pechelbronn field by underground drainage was revived, with a view to obtaining a further supply of oil from the areas exhausted of oil by drilling methods. The procedure, however, was modernised, and the operations were put in charge of skilled mining engineers. The results obtained were startling. A lenticular body of oil sand of no great area, which had ceased to produce by the usual pumping methods, was opened up by two shafts and connected by underground drives, so that a perfect system of ventilation could be adopted. From the drives, drains were made to a sump into which the oil collected, and from whence it was pumped to the surface. From this "exhausted" area, 21,000 tons of oil had been obtained from four wells in ten years. By the new system, 51,000 tons of oil were obtained in three and a-half years and, apparently, the lens is still yielding oil.

The details of working and the results obtained have been given by M. Paul de Chambrier in an article in a recent issue of *Les Matières Grasses*, under the title of "L'Exploitation de Petrole par Drainage souterrain," and also by Mine-Director Schneider in a recent issue of *Petroleum*. Both of these men took an active part in the operations and, therefore, the information and the comments expressed are first hand. Of the two articles, that of Schneider is the most comprehensive, as he appears to have designed the method of exploitation and to have himself superintended the carrying of it out. The full details, cannot, for lack of space, be given here. Suffice it to say that they are of a character quite within the capacity of the average mining engineer.

The oil yield amounted to 11 tons per metre—39in.—of drive, and the sand excavated yielded a further 2 tons of oil per metre by washing it with hot water. A daily production of 100 tons of oil was very soon reached, and this could have been increased almost indefinitely if refinery capacity had been available to deal with it. In a few months the total expenditure on the mine development and equipment had been fully recovered in the value of the oil obtained.

The Pechelbronn oil is of a high viscosity, and the area drained was comparatively small. Schneider believes that with an oil of greater fluidity, and with an area of oil sand much greater than that of the Pechelbronn lens, the yield per metre would be much greater.

In Ontario are much thicker beds—up to 80ft.—saturated with an oil much resembling the Pechelbronn oil. These beds have practically ceased to produce oil to the ordinary pumping method, but Schneider has made calculations which show that if the drive system were adopted, and the bed taken as 15ft. thick only, the yield of oil could be increased to at least fifty times that already obtained by drilling.

Many of the United States fields now "exhausted" are of a somewhat similar character. In parts of the Pennsylvania field the yield of oil has been from one-twentieth to one-fortieth of a ton per square metre, and in West Virginia about one-twentieth of a ton. In these cases Schneider estimates that from thirty to thirty-three times that quantity is still recoverable by the shaft and drive method. At Spindeltop, in Texas, the porosity of the oil sand is 33 per cent., and yet only 6 tons of oil per square metre has been recovered. These are exceptional cases, but Schneider is of opinion that very nearly all of the United States fields now practically "exhausted" might be expected, at the lowest estimate, to give results equal to those obtained at Pechelbronn by adoption of the drive system.

Many regions too poor in oil to be profitable for drilling might be exploited by the drive method with excellent chances of proving highly profitable. The reasons why drilling fails to give results in sands known to be saturated with oil may be due to the absence of gas pressure, the high viscosity of the oil, or too great resistance to oil movement in the oil sand. The opening up of a drive in such cases produces results unexpected, without experience. The capillary attraction of the sand pores for the oil is largely broken down and the oil, otherwise held tenaciously, yields itself freely to the relatively large opening in the sand formed by the drive.

As examples of the quantities of oil in saturated sands, it may be stated that a sand 30ft. thick with a pore volume of 10 per cent. will contain about 2,500,000 tons of oil per 2.5 square kilometres, or a daily output of 500 tons for ten to fifteen years. The Spindeltop field would yield about 5,000,000 tons of oil per square kilometre if all could be recovered. It is estimated that the life of the United States oil fields, recently calculated at about twenty years on the basis of present production, could, by the drive method of recovery, be extended for at least a century on the same basis of output. If this estimate is approximately correct, the adoption of the drive method seems to be one of the great needs of the near future, and its economic effect on oil supplies can scarcely be exaggerated.

In discussing the question of winning oil in the manner suggested, it is necessary to consider two practical points. First, the danger of fire in oil underground workings is one which seems rather obvious. This danger, however, is said to be practically eliminated by a perfect ventilation scheme by which the air around the workings is frequently renewed. Fireproof material should be used underground, and fireproof doors should be provided at suitable places to shut off and localise a fire should such occur. Boring ahead of the excavation in a drive is recommended to prevent surprise by a sudden inrush of gas or oil resulting from the tapping of a "pocket." If this is tapped first by a bore-hole, the possibility of control is obtained. Portions of the workings temporarily dangerous by excess of gas can be closed off by the fire-doors.

Another point of practical importance to be considered is the driving in loose sands often found in oil beds. Schneider describes the practical and special means adopted at Pechelbronn to protect the miners from falling roofs and sand caving. The maintaining of the drives, when once open, seems possible by packing them with large rock fragments which would permit drainage and air passage and cost little. Such drives as are needed for travelling ways would have to be otherwise supported. It goes without saying that the conditions in many respects resemble those of a "gassy" coal mine, and require the same precautions. According to Schneider, the danger to the workings and the people in them is small if reasonable care is taken.

The comparative costs of the drilling method and the drive method cannot be stated with accuracy because of the small amount of data available as to the latter. But some idea can be formed, and Schneider seems satisfied that a comparison would be greatly in favour of the drive system, particularly on the basis of per ton of oil won. His estimate of the cost of a shaft and drives is that it would certainly not exceed the cost of ten drilled wells. Taking the Pechelbronn production as a basis, one shaft is as productive as twenty drilled wells in California, where the average daily production per well is 37.8 barrels, or as 3500 drilled wells in New York State, where the oil production is only a fraction of the Californian average. The cost of maintenance is believed to equally favour the drive method. Wells require constant attention to keep them in working condition, while the attention to be given to shafts and drives and the necessary equipment, all easily seen and accessible, is small in comparison.

The profits of exploitation by the drive system, which, it must be remembered, can be applied to fields which have been "exhausted" by the drilling method, would doubtless lack the sensational character of those which have rewarded a few of the more fortunate oil drillers, but they may be expected to be, generally, very substantial, steady, and enduring for a much longer period.

The idea of driving for oil is a new one to most oil seekers, but a consideration of the possibilities in the light of the Pechelbronn experience will probably lead to a development of this method of obtaining oil from fields abandoned by the driller. How far the drive system can be used for very deep oil sands remains to be seen. In the meantime there are many relatively shallow abandoned fields where it can be adopted without doubt as to its practicability.

The Earthquake in Japan.

We have been favoured by Sir Robert Hadfield with a copy of a letter which was written by the representative of his firm in Japan, and which is herewith reproduced. It requires no further introduction.

"I was in Yokohama when the earthquake occurred at 11.55 a.m. on September 1st. I had just left your head office, and was on the bridge leading to the Sakurongicho Station, when, in an instant, the earth seemed to upheave, quite unlike anything I have ever experienced and quite unlike my experience in the earthquake in Messina. I was thrown out of my rickshaw, the man was flung face down, a dray and horse simply turned upside down, the rickshaw in front of me collapsed like a pack of cards, and the foreigner inside I never saw again. The bridge was moving from side to side and up and down; as one foot was put down it simply went from under one. The only thing to do was to jump and keep on jumping wildly until one reached the open space in front of the station. . . . When I got off the bridge, the earth in front of the station almost gave way when the water main and gas pipes burst; at the same moment the whole station collapsed. One was unable to stand, and was lifted and thrown about like a cork. For one instant I turned round in vain to look for my bag, when I saw the Bankers' Club, at the entrance to the Honcho-dori, standing at an angle of 45 deg.; again turning, I saw the whole place on the other side had collapsed, fire leaping in bounds from Theatre-street; turning again, the Bankers' Club was a sheet of fire, then the docks, and Yamate, Yamashita-cho appeared to be a sheet of fire, so far as one could judge. Even in this short space of less than ten minutes, the dead were all around one; hardly anything that was not bleeding. I judged the only thing to be done was to at once make for Yokohama Station, if it were possible. What was undoubtedly a curious coincidence was the sulphur fumes that arose—I don't mean the dust smoke from fires, but sulphur which came up within, say, one minute. I am quite sure that a great many died from simply being suffocated by this. I managed to reach Yoko. Station, and outside met two American tourists who had been fortunate in escaping from the restaurant at the station. How many were killed they did not know. They made for Yokohama and, I fear, may be no more. On the station I found the Dr. Solf, the German Ambassador, secretary, and Mr. and Mrs. Satchell, of the B. Air Mission from Kasuonegaura, and one other, also from the Mission, also Miss Satchell, fourteen years old. They were on the train, and just managed to get out in time. They were wishing to remain on the station. I did my utmost to get them away, and when the oil tanks caught fire they were willing to leave with me. The delay was very foolish, for by the time we set out the Yoko. Wire Works were blazing and fire on both sides of the rail line. The Ambassador still further delayed, and only just managed to get through in time after us. The track has mostly entirely gone. We found Modagayee devastated, except a few homes on the mountain. Owing to the collapse, partly, of Miss Satchell, we were much handicapped, and only reached Totsuke with difficulty. Two trains were entirely disrailed.

"At Totsuke we found the place entirely gone, and fire as well. We slept in the roadway outside the station; all stations have tumbled like a pack of cards. The next day we set out at 6 a.m. and reached Ofuna safely. The old Totsuka tunnel stood, wonderful to relate; one nasty crack, otherwise good at present, for we all walked through it with our hearts in our mouths. The new tunnel has collapsed.

"At Ofuna the others all left me for Yokosuka and Kamakura, and I hope are now safe. Kamakura, Kugionima, Dyushi, have all gone. The Kaihury Hotel has collapsed. How many are killed I do not yet know.

"I went on to Oiso to see if my family were alive. Fujisawa is devastated with fire; Tsujido has suffered little; Chigasaki is likewise fairly good; Heidtsuka has almost all gone, and the explosives works, schools, &c., all gone. Much loss of life there. The bridges over the Bannu River have all collapsed, very swift current now, and very slow progress to get across.

"I at last reached Oiso about done up, and thankful to say found my wife, sister-in-law and all alive. My wife had a damaged head and face from a house falling on her. My house, or one I rented from Mr. M. Kato on the mountain side, has partly collapsed, all the other houses have gone near us. Ours is still holding, but dangerous. We have saved a few sticks.

"May I ask you to excuse many mistakes, but I am unable yet to collect my thoughts, and my hand is still most uncertain."

THE ROAD TO SUCCESS.*

The best staff men are those who, by their adaptability and willingness, attract work, and if they are capable of carrying additional work and responsibility they will either create an improved position or be met by opportunities for promotion.

The man who proves capable and willing is usually loaded to his full capacity in any live business. On the other hand, the man who is continually wanting his position accurately defined seldom develops a good position. I do not believe too much routine or over-organisation applied to commercial affairs, will bring out the best men or the best in a man.

It is desirable that businesses should give the members of their own staffs opportunities, so far as possible, for development, and the business which is continually looking outside instead of to its own staff for talent is not sound. There is a risk of occasional failure in placing responsibility on members of one's own staff, but the risk is, on the average, considerately greater if men are taken from other staffs.

A common idea is that men of engineering genius will produce excellent work by acting on inspiration, this being associated in most people's minds with spasmodic work. Inspiration may be responsible for some improvements, but in the engineering profession there must be a good deal of continuous "grind" if the individual is doing his duty; good results are seldom obtained without perseverance and regular work.

I would like to urge the younger men to set a high conscientious standard of work without too much hope of immediate reward. In early life it is more important to gain experience and develop one's powers rather than earn large salaries. The mental satisfaction of work well done transcends any pecuniary reward.

The chief goods manager of the Great Western Railway has issued a circular, a copy of which has been handed to each member of the staff, making suggestions as to how to meet the wagon shortage experienced on that system. There is a sufficient number of wagons for the traffic, if properly served, but there has been a general tardiness in loading, unloading and moving wagons. Save a wagon-day every day is to be the aim.

* From Mr. Cecil Bentham's Presidential Address to the Manchester Association of Engineers.

The Diesel Electric Ship La Playa.

No. II.*

The Main Engines.

The main engines of the La Playa are of interest as representing a new departure in Camellaird-Fullagar design. They comprise four four-cylinder units conveniently spaced across the whole breadth of the ship. The four cylinders are each 14in. in diameter with 16in. stroke, and are designed to develop 825 brake horse-power when the engine is running at a speed of 250 revolutions per minute. We show in the accompanying illustrations—Figs. 1 and 2—views and also a section through the engine which will serve to make clear the new features. In many ways the new design of engine resembles closely that evolved by the English Electric Company, Limited, for land work, which was described in The Engineer of April 28th, 1922, but here again important departures from the usual practice may be noted. In order to cut down weight and to take full advantage of the limited space available aboard ship, the fly-wheel has been reduced in size, and provision made for an extended bed-plate, bolted directly to the main engine bed-plate, which carries the propelling and auxiliary generators and the necessary supporting bearings. Also, the air compressor has been transferred from its usual place at the forward end of the engine to the after or dynamo end, giving increased accessibility to the forward main crosshead. The compressor is a three-stage machine driven from the main crank shaft and its intercoolers, with upper safety valves, and lower drain pockets are neatly mounted on the main crank case. At this end of the engine, on the working platform, there is arranged the air compressor throttle valve, the governor and fuel controls and a tachometer, indicating the speed at which the engine is running.

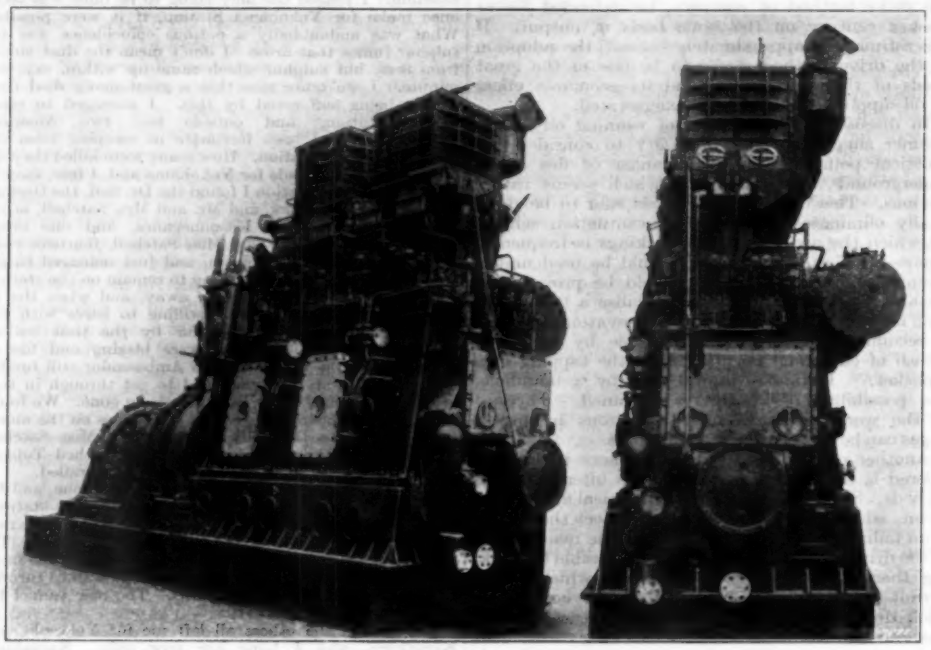


FIG. 1—825 B.H.P. CAMELLAIRD-FULLAGAR ENGINE

As the engine is driving a generator, reversing gear is, of course, not required, and this has rendered possible a considerable simplification in the valve gear. The usual cam shaft has been dispensed with entirely, and the fuel cams placed on the crank shaft. In the sectional drawing—reproduced in Fig. 2—the fuel cams and rollers will be seen between the crank webs and the main centre bearing and also on the inner sides of the next outer bearings.

At the forward end of the crank shaft is a large excentric, which drives the fuel pumps through the two vertical push-rods, shown in the right-hand view—Fig. 1. Each rod operates two fuel pumps, which are placed at 180 deg. phase, with one pump delivering its oil at 90 deg., or in phase with the main cranks. An arrangement of this kind permits of very close governing, since when the governor is called upon to vary the amount of fuel oil delivered there is never more than one fuel delivery stroke on the wrong side of the governor. Special under-speed and overspeed attachments are provided on the governor. One of these controls takes the form of a limit switch to prevent the operator from slowing up the propeller motor too quickly. The switch, which is fitted to each engine, regulates the supply of current to the small rheostat-operating motor on the control panel, and is set so that when the engine governor cuts off the fuel supply owing to the speed rising, the switch is automatically opened and the rheostat motor stops. This switch effectively prevents engine racing. Another device prevents the supply of fuel taking place should one engine stop, and be motored in a reverse direction by the other three generators.

The same crank shaft excentric which drives the fuel pumps serves to control the air starting gear, which is fitted on two lines of cylinders only. The air-starting valves are arranged to work at 180 deg. phase difference, and they are placed at the end of the engine near the fuel pumps, pipes being led from this point to the automatic starting valves on the engine cylinders. On the two wing engines, the same excentric drives in addition the bilge and sanitary pump.

Lubrication of the engine is effected by means of a series of sight-feed pressure lubricators placed on the cylinder casing above the working platform. They are of the Empire patented direct mechanical type supplied by the Empire Engineering Company (Manchester), Limited. Each engine has four lubricators, with eight tubular sight glasses, for the lubrication of the cylinders and various bearings, while a single lubricator with four feeds and bull's-eye sight glasses is provided for the compressor. The lubricators are constructed so as to discharge oil with every stroke of the plunger, and there is a wide range of adjustment. If required, each feed can be flushed independently. The main oil circulating pump is driven from an excentric on the crank shaft.

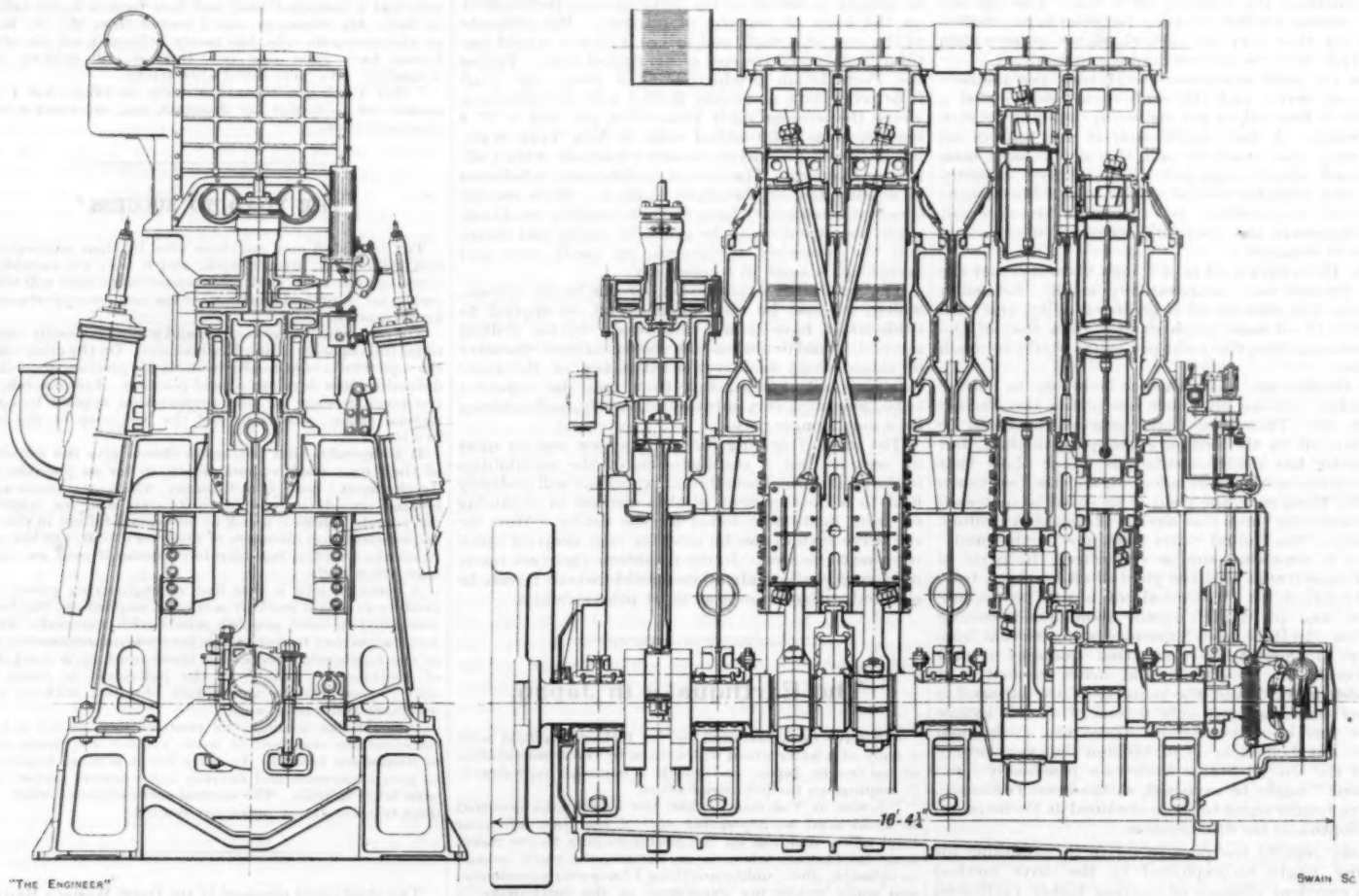


FIG. 2—END AND SIDE ELEVATIONS OF 825 B.H.P. CAMELLAIRD-FULLAGAR ENGINE

The Machinery Arrangement.

The sectional elevation—reproduced in Fig. 4—

* No. I. appeared October 19th.

shows the way in which the various machinery is laid out. In the top of the engine-room casing, at main deck level, are the two auxiliary boilers for galley and heating service, and also for supplying steam to the shore fruit elevators. They are fitted with the Hutchison Turbinia oil-burning system, in which the oil is supplied to the burners by gravity, and is atomised by air at 8in. to 12in. water pressure. The compressed air for this purpose is supplied from an electrically-driven blower. The donkey boiler is 9ft. 9in. in diameter and 9ft. 4in. long, designed for 140 lb. steam pressure, the galley boiler being 7ft. by 3ft. and designed for 80 lb. pressure.

The refrigerating machinery is accommodated in a flat in the main engine-room at main deck level. It comprises two horizontal single marine type No. 14½ CO_2 machines, by Hall, of Dartford, for the fruit holds, and a smaller No. 7 machine for the provision chambers of the ship. All the machines and also the brine pumps are electrically driven, and the motors driving the main refrigerating machines are designed to develop 100 brake horse-power. These motors are fitted with variable voltage speed regulation, and have a range of from 165 down to 30 revolutions per minute. Special care has been taken in designing the motors, so that good commutation is obtained at the exceptionally low speeds at which they are required to run.

At the after end of the engine-room, running 'thwartship at lower deck level, is the switchboard flat. The front part of this space is taken up by the main propelling motor controls described in our last article and also the isolating switches, while in the port wing is placed a Weir electrically-driven auxiliary air compressor arranged to take current from the emergency generating set, and space is set apart to form an engineers' stores. In the starboard wing there is a 25-kilowatt emergency generator driven by a three-cylinder Gardner petrol-paraffin internal combustion engine. Alongside this set is a 220 to 110 motor generator, which is used for supplying 110-volt lighting current at sea and also for starting up the emergency generator if required to do so. The centre part of the flat is occupied by the main switchboard for lighting and auxiliaries, which is shown in Fig. 3. It comprises fifteen panels and has an overall length of 32ft. Five of the panels are generator panels, one for each of the auxiliary generators, and the fifth for any of the main propelling generators which may be used at any time for supplying auxiliary load. Each panel is furnished with indicating lights, which show at a glance when an auxiliary generator is supplying excitation current for the propelling equipment. The excitation panel, which is adjacent to the auxiliary generator panels, is also fitted with lights to show when the auxiliary generators and the main refrigerating machinery motors are running under separate excitation conditions. The remaining panels on the board are used for the distribution of light and power throughout the ship. Lighting is carried out on a 110-volt circuit and power at 220 volts.

For the size of the ship there is an unusually complete installation of electrically-driven engine-room and deck machinery. Altogether the auxiliary power installation, including fans, pumps, compressors, winches, and windlass, comprises some thirty-nine motors ranging from 1 up to 100 brake horse-power and having a total horse-power of 950. All this machinery was supplied by the Sunderland Forge and Engineering Company, Limited, to the specification of the United Fruit Company, and the same firm carried out the installation and wiring work, including the switchboard and fixing the necessary connecting cables. The deck machinery, also supplied by this company, includes nine Sunderland Forge type electric worm-geared winches, each designed to lift 10,000 lb. at a speed of 85ft. per minute and driven by a 32 brake horse-power motor complete with water-tight control gear. One of the winches placed aft is furnished with special extended ends for warping. The windlass is driven by a 52 brake horse-power motor. In our last article the construction of the propelling motor was described. The drawing—shown in Fig. 5—gives a plan and elevation view of the motor room, and illustrates the arrangement of the propelling motor, thrust block and tail shafting. The fans for air cooling are also shown along with the air ducts to the motor.

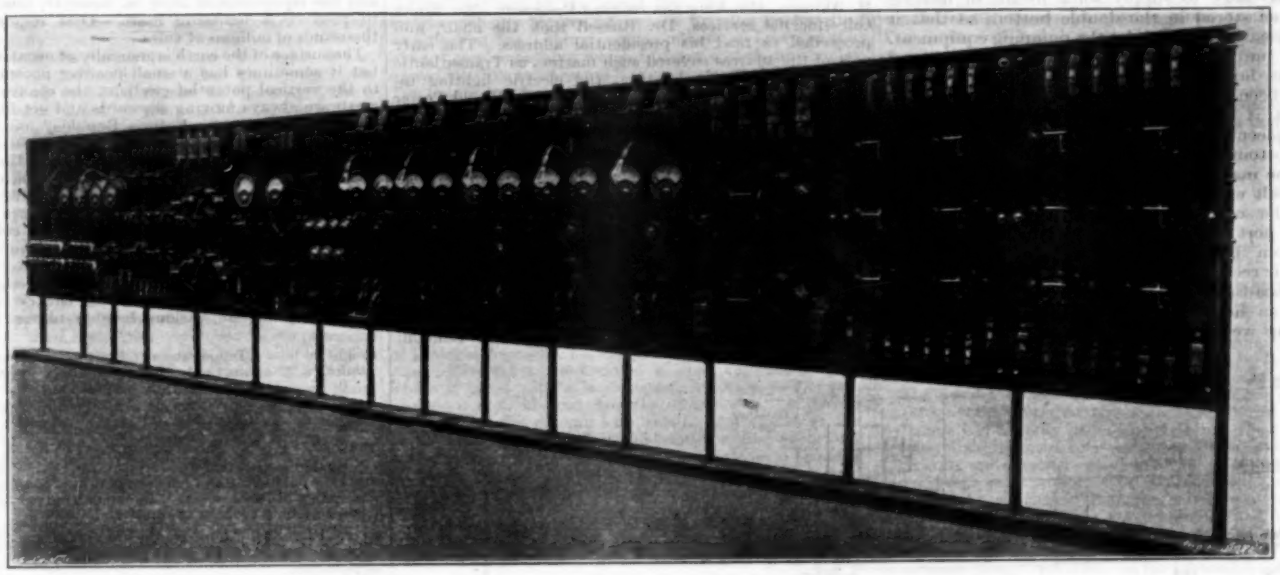


FIG. 3—THE SWITCHBOARD FOR THE AUXILIARY POWER AND LIGHTING CIRCUITS

Engine-room Auxiliaries.

The larger portion of the electrically-driven auxiliary machinery in the engine-room is placed along the aft bulkhead on the bottom platform. There are two centrifugal circulating water pumps for supplying cooling water to the main engines, either pump being designed for the full capacity, so that one may be used as a stand-by. A third centrifugal pump deals with the circulating water for the refrigerating plant, and the pipe connections are so arranged that either of the two engine water circulating pumps can take up this duty if required. A 60-ton pump is provided for sanitary and fire purposes, and all the four pumps mentioned are of the horizontal type, coupled direct to the driving motors, which are mounted on a common bed-plate.

The fresh water pump is of the Drysdale 25-ton vertical spindle "Centrex" type, and another pump of similar design, but with a 65-ton capacity, is provided for the ballast and bilge duties. An electrically driven duplex Weir pump of 25 tons capacity is used for oil transfer duty, and there is in addition an Albany motor-driven pump for stand-by lubrication. In connection with the lubricating oil service a De

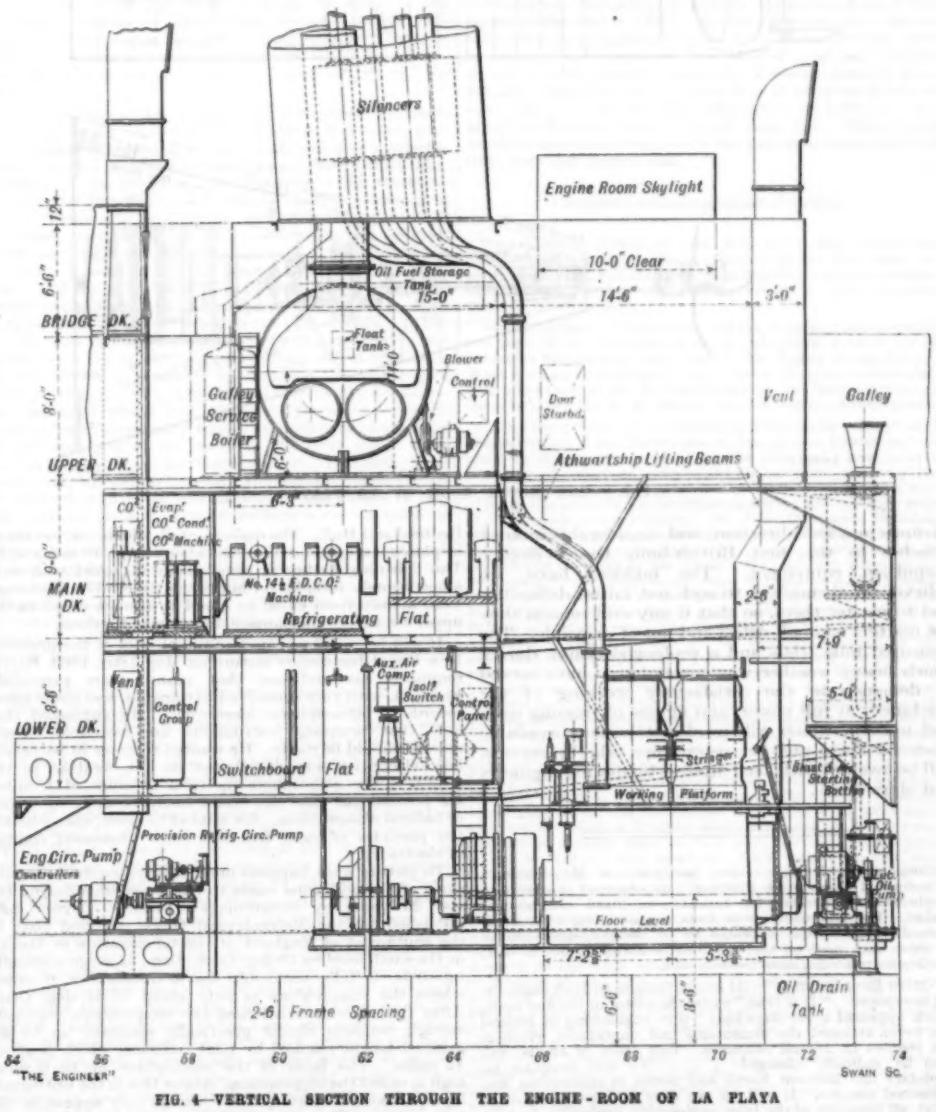


FIG. 4—VERTICAL SECTION THROUGH THE ENGINE-ROOM OF LA PLAYA

Laval centrifugal oil purifier is installed. Other pumps in the engine-room include a 25-ton oil fuel transfer pump, by Weir, and a 50-ton duplex pump, by Lamont, together with two small Weir pumps for boiler feeding and fresh water duties. All of these units are worked by steam from the auxiliary boilers. Owing to the very severe weather conditions frequently experienced in North American ports, it was necessary to supply some means of heating the oil fuel stored in the double bottom so that it could be easily dealt with by the pumping equipment. For this purpose the R. and D. system of Rand heaters for liquefying the oil is used. After the oil fuel has been raised to a high temperature in the heaters it is discharged through revolving nozzles fitted adjacent to the oil fuel suction pipes in the double bottom tanks. By this means the temperature of the main body of fuel oil is so raised that it can be dealt with by the pumps and flows with ease through the service suction pipes.

In the port and starboard wings at the forward engine-room bulkhead are placed the blast and starting air receivers for the main engines, and along this bulkhead are the oil coolers and the lubricating oil pump, as shown in Fig. 4.

The ship we have described marks an important advance in a new direction, and considerable interest attaches to this first British-built Diesel-electric propulsion equipment. The builders have, we believe, set themselves to seek out initial difficulties and to master them, so that if any still remain they are matters of small detail and not of principle. The measured mile trials and a prolonged cruise, during which heavy weather was encountered, have served to demonstrate the satisfactory working of the machinery at full power, and figures of running costs and upkeep, which will no doubt become available when La Playa and her sister ships take up service, will be awaited with keen interest by marine engineers and shipowners.

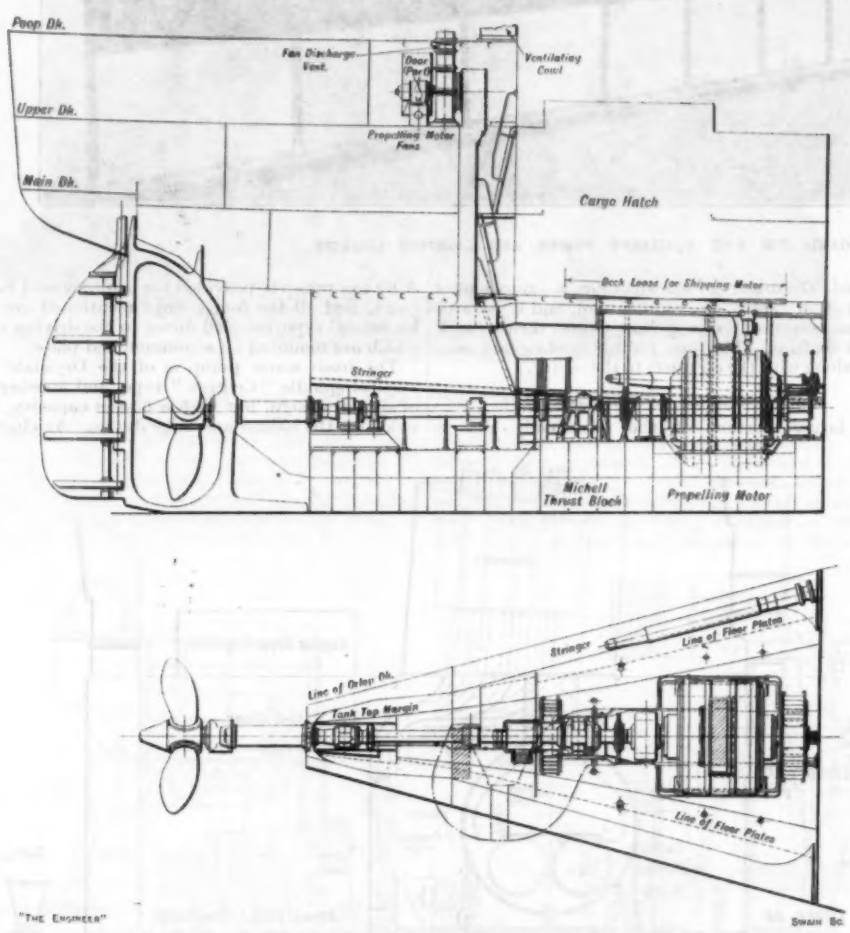


FIG. 5—THE MOTOR ROOM OF LA PLAYA

CORRECTION.—In our review last week of Mr. Warren's "Century of Locomotive Building," we observed that certain Stephenson locomotives for Russia were fitted with sledge-brakes. The statement arose from a misreading of a small scale drawing. What appeared to be sledge-brakes—similar to those once used on the Taff Vale Railway—were, in fact, brushes for removing snow from the rail.

"IRISH ENGINEERING."—At length there is an Irish engineering newspaper. "It is true," writes the editor in the first issue, which appeared a few days ago, "that engineering in Ireland has never attained the dimensions and importance which it has reached in normal countries. This state of affairs will soon be radically changed. . . . We will recognise no boundary line between North and South in engineering and industrial matters. It will be our duty and our pleasure to assist all branches of the Irish engineering profession to take the leading and important place which is their right in the new, progressive, and prosperous Ireland." The new paper is an illustrated monthly, it is published at 40, Lower Ormond Quay, Dublin, and is called *Irish Engineering*. The first number is an attractive production.

Institution of Electrical Engineers.

ON Thursday evening of last week, the opening meeting of the Institution of Electrical Engineers was held at the Institution's headquarters. After the premiums had been presented, the new members of Council announced, and speeches had been made by Dr. Ferranti and Mr. Llewellyn B. Akinson, thanking the retiring President—Mr. Frank Gill—for his services, Dr. Russell took the chair, and proceeded to read his presidential address. The early part of the address covered such matters as Transatlantic radio-telephony, broadcasting, the electric lighting industry, the British Empire Exhibition, the World Power Conference, the electrical installation industry, the lamp-making industry, Post Office automatic telephony, long distance communication, developments in radio-telephony in the General Post Office, railway electrification, research, the Kelvin centenary, relativity, atomic theory and thunderstorms. The succeeding portion of the address, which dealt with thunderstorms, was, in our opinion, the most interesting part, and we publish it in full below.

A remarkable thunderstorm visited London on the night of July 9th-10th, 1923. The storm appeared on the south coast and progressed W.N.W. at a speed of about 25 miles an hour, travelling through London, Bedford and Hull. The main rainfall, which was torrential in places, extended over a belt about 30 or 40 miles wide. The lightning flashes in some places occurred with only a few seconds' interval for hours at a time. The discharges were mainly from cloud to cloud or from a cloud to the upper air, and so the damage done was not serious.

It will be useful to consider the physics of the problem. In a Royal Institution lecture on May 18th, 1860, Kelvin reminded his audience that many years previously Beccaria, with very sensitive instruments, had made many records of atmospheric electricity. He suggested that now that accurate instruments are available careful records should be made. He wanted to know in particular how electricity was distributed in fine weather in the strata of the atmosphere up to a distance of 6 miles. He pointed out that this could easily be done by means of balloon observations. He wanted to know, also, whether the particles of rain, hail and snow possessed charges of electricity.

To picture what happens more clearly, we shall describe some of the additions made to our knowledge during the last 25 years by meteorological science. From data published by the Meteorological Office, we find that in the south-east of England, if the temperature of the air at the earth level be 10 deg. Cent., then, as we go vertically upwards, it falls uniformly for a distance of 6 miles, where the temperature is only about — 53 deg. Cent. After this altitude is attained the temperature, curiously enough, remains almost practically constant up to the greatest height reached by pilot balloons, which is about 12 miles. The layer of the atmosphere up to 6 miles high is called the troposphere. Above this is the isothermal layer called the stratosphere. Clouds only appear in the troposphere. There is very little moisture in the strato sphere. For example, practically no snow falls on the top of Mount Everest. The snow on it is blown up from lower down the mountain.

On a calm day, as we go upwards, the electric potential gradient diminishes. In midsummer a usual ground value is of the order of 100 volts per foot. In midwinter the average ground value is at least twice as high. In foggy weather it is sometimes greater than 500 volts per foot. In fine weather the potential difference between the ground and the top of the troposphere is of the order of a million volts, and above this the potential gradient is practically zero, and so the isothermal layer is also an equipotential layer. This voltage between the earth and the equipotential layer is, however, much too small to produce a lightning flash. That requires at least thousands of millions of volts.

The surface of the earth is generally at negative potential, but it sometimes has a small positive potential. Owing to the vertical potential gradient, the electrons from the earth are always moving skywards and act like a vertical earth air current. Sir Francis Ronalds,[1] one of the early members of the Institution, made observations at Kew Observatory for the British Association. He found that the intensity of the atmospheric electrification had a maximum value every morning and another maximum value in the afternoon. Chree[2] has shown that these maxima values are usually greatest in cold weather. Possibly, therefore, they may be due to smoke or other impurities in the atmosphere.

The following table may be taken as roughly typical of the temperature, pressure and electric strength of the atmosphere at various heights above the ground up to 12 miles. The ground temperature and pressure are supposed to be 15 deg. Cent. and 760 mm. of mercury respectively.

Height in miles.	Temperature, Cent.	Pressure in mm.	Electric strength in kilovolts per cm.*
0	15	760	28
3	— 15	412	17
6	— 50	206	10
9	— 50	96	4.6
12	— 50	44	2.1

* By the electric strength of air we mean the maximum electric stress it would withstand between two very large spheres at an appreciable distance apart. The numbers given at the greater heights are only roughly approximate.

The table shows that at a height of 3 miles the temperature is below the freezing point, and the electric strength of the air is only about half what it is at the surface of the earth. At a height of 24 miles, the barometric pressure would only be about 2.4 mm., and the electric strength would only be of the order of some hundreds of volts per centimetre. At some height, probably about 30 miles vertically up, the electric strength would attain a minimum value. At greater heights it would begin to increase very rapidly, and soon become at least 30 times greater than the electric strength of air at ground level.

J. L. R. Hayden[3] placed two 1 cm. spheres in a kenotron bulb at a distance of 0.3 cm. apart. At atmospheric pressure the disruptive potential gradient was 47 kilovolt per centimetre, but with an excellent vacuum a gradient of 1235 kilovolt per centimetre was required to break down the gap. A good vacuum, therefore, has an electric strength at least twenty-six times the strength of air at ordinary pressures.

In a recent paper,[4] F. W. Peek has shown that a much higher impulsive voltage—that is, a voltage similar to that which causes Lodge's B flash—is required to spark over a given distance than a voltage at ordinary working frequencies. He also shows that some substances which act as conductors at working frequencies can be punctured by impulsive voltages. For instance, he found that an impulsive voltage of 149 kilovolts broke down the gap between two 1in. spheres, immersed in water, at a distance of 1in. apart. The conducting water, therefore, acted as if it were a dielectric having an electric strength between three and four times that of air.

It is easy to get a discharge from an electrode to the surface of water. The author remembers once being in a small boat on the sea on a perfectly calm day during a thunderstorm. Where the lightning struck the sea a narrow column of spray, or, more probably, steam, seemed to rise suddenly not unlike the splash made by a gannet when diving. Possibly, when a flash of lightning strikes sandy soil and forms a fulgurite, vapour or smoke might be observed.

When it is considered that two million volts will only bridge a few feet in air, the voltage of a lightning flash to earth must be exceedingly high. We can conclude from laboratory experiments that the electric resistance of fog or mist is greater than that of clear air, but that its electric strength is much the same.

Let us now consider very briefly the mechanism of a thunderstorm. Owing to the small potential differences produced by the ordinary earth-air electric current, and, consequently, the minute amount of electrostatic energy stored in the field, we are justified in assuming that the most important function of this current is in assisting to start the storm. A thunderstorm usually travels over considerable distances, and keeps on generating prodigious quantities of electrical energy. It functions like an electrostatic machine driven by a very powerful motor. We have to consider what produces the energy which the lightning flash converts into heat, light, sound and radio waves. Aviators and balloonists report that the air in the centre of a thundercloud is practically always moving upwards with considerable velocity. In the upper layers of the troposphere, owing to ionisation, there are sometimes many free electrons. If the humidity of the upward current of air be high enough the vapour condenses round the electrons, and so the air is full of minute globules of water. Some of these coalesce together, forming larger drops. If the vertical velocity of the air be greater than 8 m. per second—17 miles per hour—the large drops, as they are blown upwards, often break into smaller drops. Experiment shows that the charge on the smaller drops is generally negative, and on the larger drops positive. As the larger drops are often kept oscillating in the higher and very cold strata of the atmosphere, owing to fluctuations in the velocity of the air currents, they keep melting and freezing again, producing

[1] *Cf.* W. Snow Harris: "Rudimentary Electricity," 1848.

[2] *Philosophical Transactions*, Vol. 206, p. 299.

[3] *Journal* of the American Institute of Electrical Engineers' 1922, Vol. 41, p. 853.

[4] *Ibid.*, 1923, Vol. 42, p. 623.

ordinary hailstones. As the gusts vary, we have the large drops and hailstones positively charged descending downwards. Electrical energy, due, partly, to the work done by gravity on the descending drops and by the air currents on the ascending drops, is stored in the atmosphere. On the upper part of the cloud we have a negatively charged layer, and on the lower part a positively charged layer. The falling drops keep increasing the potential difference until it gets so high that a disruptive discharge ensues.

We have imagined the cloud to be bipolar. Several kinds of electric discharge can, therefore, ensue. We may have brush discharges between the upper layer, and the better conducting layers higher up. Some kinds of sheet lightning could be caused in this way. On a summer evening it is not very unusual to see sheet lightning in broad flashes coming from a cloud and ending in the upper air. An ordinary flash, also, has sometimes been observed to end in clear air. If another cloud drifts up we may have a flash between the upper layer and this cloud. We may have flash discharges between the lower layer and the earth or another cloud. Possibly, also, we may have a flash-over between the two poles of the thundercloud when they are not too far apart. C. T. R. Wilson[5] describes this phenomenon by saying that the cloud may be short circuited.

Operations of this nature happen during a thunderstorm. The separation of the charged drops due to the differences in their velocities produces high potential differences. There is plenty of energy available. The work done by an inch of rain falling a mile is 27,500 foot-pounds, or the one-hundredth part of a kilowatt-hour, per square foot of the earth's surface. It has recently been shown that in general the purer the raindrops the greater are the electric charges they assume on pulverisation.[6] In particular, any contamination of a raindrop with sodium chloride diminishes the charges produced when it breaks in air. This, possibly, has the effect of diminishing the intensity of thunderstorms at seaside towns. It has been suggested that the introduction of ammonia into the upper layers of the atmosphere would hinder the development of a thunderstorm. To utilise this practically, however, could rarely be attempted, as a thunderstorm usually covers a large area.

What we, as engineers, are specially interested in is how to protect buildings and apparatus and power and communication lines from damage due directly, or indirectly, to lightning flashes, or to the gradual accumulation of electric charges. I think that there is no need to call a second Lightning Rod Conference. The principles laid down by Sir Oliver Lodge[7] in this Institution in 1889 still hold good. They have been adopted by the Lightning Research Committee of the Royal Institute of British Architects.[8] In practice, they are found quite satisfactory.

We now know that lightning discharge is unidirectional, although it may be rapidly pulsatory. But even a unidirectional discharge gives rise to an alternating current in line wires, and may give rise to alternating currents in lightning conductors. The wires in insulated conductors have been found broken into small pieces by a lightning discharge. This seems to point to rapidly alternating currents. Lodge's A and B flashes of lightning are known to all students of electrical engineering. The B flash, which is the dangerous one, is also referred to as an impulsive discharge. I think that, possibly, too much stress is laid on the importance of having a low resistance to earth of a lightning rod. About 25 years ago, I measured the resistance to earth of the conductor of a large chimney stack. It came to 70 ohms. As the end of the conductor was buried in coke I had it dug up to examine the earth plate. This was found to be a brick placed there 20 years previously by the workmen who erected it. I was told that the conductor had several times been struck by lightning and acted quite satisfactorily. I have noticed that workmen, before the test is made, sometimes pour a pail of water on the spot where the conductor enters the ground. Possibly, they think that a high earth resistance is a reflection on the way they perform their duties.

Difficult problems sometimes arise. I remember once considering how to protect a very large iron water tank supported by iron pillars on the summit of a hill and naturally making an excellent earth through the water pipes at its centre. As the outside iron pillars were embedded in concrete, it was thought advisable to connect them directly to earth by means of earth plates.

I think it highly desirable that records of curious lightning phenomena should be kept. In the eighteenth century this was done; the "Philosophical Transactions" of the Royal Society before 1800 contain very many interesting records. If we knew exactly the mechanism of thunderstorms, the need for recording unusual phenomena would not be so urgent. Faraday was very doubtful about the existence of globular lightning. In his "Experimental Researches," Vol. II., page 525, he says: "It is more than doubtful that they have anything to do with atmospheric electricity or lightning." Even W. J. Humphreys, in his recent excellent book on the "Physics of the Air," says: "Doubtless many reported cases of ball lightning, probably the great majority, are entirely spurious, being either fixed or wandering brush discharges, or else nothing other than optical illusions due, presumably, to persistence of vision." After these weighty statements, I now give my own experience.

Many years ago, when I was on the coast of Ayrshire on the west side of Scotland, I saw what I consider to be globular lightning. Although the visibility was very fair, there was a curious haze higher up. The ground potential gradient was probably high. Suddenly, two spheres of incandescent gas of a dull reddish colour, about 20ft. or 30ft. up, moved slowly in from the sea. They were each about 1ft. in diameter. One of these hit the wall of a building, but did no apparent damage, although it made a loud report and considerably startled the inhabitants. The other drifted away.

I consider that the evidence in favour of globular lightning is overwhelming. Witnesses testify to seeing it, to hearing it burst, to finding small metal objects melted by it, and even to seeing people killed by it. I shall confine myself to describing two typical cases. The first case I take from the "Philosophical Transactions" of the Royal Society for 1781, page 42. At Eastbourne, the tenant of a large three-storey house facing the sea was standing and looking through the window at an ominous black cloud. He saw several balls of fire drop successively out of the cloud into the sea. Suddenly he was violently thrown backwards by what he described as a flash of fire. Many people outside the house at that instant saw something which in form and flame they all agreed was like an immense "sky rocket" strike the house. The tenant's clothes were torn and pieces of metal he had about him were melted. Every pane of glass in the room was completely smashed. On the ground floor the coachman and a footman were killed, and on the top floor a lady and her maid were rendered insensible. All the bell wires in the house were deflagrated.

The second case is similar to many others.[9] It is described by a sergeant[10] of H.M. 96th Regiment which was stationed at Dum-Dum, near Calcutta, in 1879, where the phenomenon occurred. The ball of globular lightning first passed over a bathing tank in which seven men were bathing. It went right through the first floor of one barracks, making one man insensible. Going out of a window it passed down the wall, moved over the end of the barrack square, and then climbed up to the roof of the next barracks, knocking off a projecting rain-water pipe. Finally, it went down a zinc ventilating pipe, where it burst with a loud report, killing a soldier who was sitting on his bed directly underneath. A current passed down the punkah wire, setting the punkah on fire. Much damage was done to the victim's rifle, parts of it being melted. Three of the men bathing were rendered temporarily deaf. Many other very similar instances could be given, the undesigned coincidences in which, as Paley would say, are very convincing.

Globular lightning seems to be a brush discharge taking place at the end of a column of air of higher conductivity than the neighbouring air. The difficulty in accepting this explanation, however, is in seeing how the conducting column can go through rooms and yet provide sufficient energy to the globe a considerable distance away to do serious damage. In certain cases, however, it may possibly get its energy from the atmosphere by another path when it bursts.

[5] "Atmospheric Electricity," Glazebrook's D.A.P., Vol. 3.

[6] T. T. Nolan and H. V. Gill: *Philosophical Magazine*, 1923, Vol. 46, p. 226.

[7] *Journal*, I.E.E., 1889, Vol. 18, p. 386; or Lodge's "Lightning Conductor and Lightning Guards."

[8] *Journal* of the Royal Institute of British Architects, 1904, Vol. 12, p. 405.

[9] "Phénomènes Electriques de l'Atmosphère," Gaston Planté, 1888.

[10] *The Builder*, October 26th, 1896, p. 339.

The Sukkur Barrage.

In the course of his speech on the occasion of the inaugural ceremony of the Sukkur Barrage, which took place on Wednesday last, the chief engineer for the scheme gave the following particulars as to the advantage which will accrue from the construction of the works:—

"The Barrage is the safeguard of the system of canals now about to be constructed. Without it we can give no assurance whatever that the canals will give a reliable supply, the lack of which has, in the past, had a demoralising effect on the people of this Province. The structure will span the great Indus and will be close on one mile in length. There will be sixty-six arched openings, each of 60ft. span, between which huge steel gates will operate. It will take the form of a double bridge, the higher of the two being necessary for the manipulation of the great gates. The lower bridge will carry a roadway, which will be open night and day. The barrage will be built of an excellent limestone obtained from the hills around.

"The vast majority of those present here to-day are familiar with the working of an ordinary canal regulator, and will, therefore, be able to visualise the working of the Lloyd Barrage when I say that it is in reality a gigantic cross regulator which will, under a system of scientific control, give the necessary supply to each canal no matter how low the level of the water in the river would have been had there been no barrage here. On each bank of the river, immediately above the barrage, large canals will take off, and these will distribute the waters of this river over an area of some 8 million acres—a tract at present partly desert.

"From the left bank of the river the great Rohri Canal, the new supply channel, and the Eastern Nara, and the two feeder canals to supply His Highness the Mir of Khairpur's lands, will take off. The Rohri Canal, which will convey water some 30 miles further south than Hyderabad, will be over 200 miles in length, and will have no less than 2300 miles of branches and distributaries.

"From the right bank three large canals will take off; the North-Western Perennial, the Great Central Rice, and the South-Eastern Perennial Canal. The North-Western Canal, the second in size of these three canals, will be just under 100 miles in length and will have some 500 miles of branches and distributaries. Its largest branch—the Khirthar—will take off near Ruk, and will flow in a north-westerly direction, cutting the existing Begari Canal in its 53rd mile. This branch, together with the Begari branch of the Central Rice Canal, which also takes off at Ruk, will irrigate all the lands at present served by the Begari Canal below its 53rd mile, as well as a considerable area in the Nasirabad Tahsil of Kelat. The Central Canal, the largest on the right bank and the second largest of the whole scheme, will be 87 miles long with over 350 miles of branches and distributaries. It will be a purely rice canal, and will only flow for about five months in each year. It will irrigate a very compact area of rice lands around Larkana and as far south as Khairpur Nathanshah, one of the finest rice areas in India.

"By its construction the very best qualities of rice can be grown, and its even and assured supply of water will enable cultivation to be commenced earlier than heretofore in each season, and be continued to a later date. This is no small advantage, for it will permit of a greater area of rice being dealt with per cultivator, and so relieve the rush for agricultural labour that occurs from time to time under present conditions.

"At the foot of the hills which form a barrier to irrigation beyond Sehwan lies the Manchar Lake—a great expanse of water. The works to be now inaugurated will include the partial drainage of this lake to permit of the early planting of winter crops on its rich marginal lands.

"The barrage itself will cost over 5¼ crores of rupees, or somewhat over 3½ million pounds sterling. Each of its great gates will weigh 50 tons, and the structure itself will be about five times the length of London Bridge. The canals will, together, enable close on 6 million acres of crops to be irrigated annually, which, at a moderate computation, will produce about 2 million tons of grain and cotton, of which over 1,200,000 tons should be available for export, and it is estimated that this gigantic scheme will be completed at a cost of 1,836 lakhs of rupees, or 12¼ million pounds sterling."

[Drawings and particulars of the Sukkur Barrage were given in our issue of August 25th, 1922.]

RAILWAY AND STEAMER SERVICE BETWEEN SWEDEN AND FINLAND.

The following further details of the proposed service between Sweden and Finland are reported by the General Export Association of Sweden:—

The Swedish-Finnish Traffic Commission has proceeded on the assumption that the connection should be made by one steamer daily in each direction. The train-ferry service first proposed has been abandoned owing to the high cost, and steamers of about 2000 tons and 15 knots have been substituted. The Commission has further come to the conclusion that the service should be conducted by the respective Governments, and be run in direct connection with the Government railways on both sides. On the Finnish side the only choice of terminus is between Hangö and Abo; as far as Sweden is concerned there are many points worth considering, including Nynäshamn and Kapellskär.

The necessary outlay on the part of Sweden would be 2,350,000 kronor for building one of the regular steamers, and 160,000 kronor for installation of more marks and beacons in the Furusund Channel, and for Finland, 23,250,000 marks for a steamer and 2,800,000 marks for the improvement of navigation in the channel leading into Abo. In addition, it would devolve on Sweden to build a supplementary steamer of the same type as the foregoing.

The Commission finally recommends that the plan be realised as quickly as possible, especially in view of the mail contract with the present steamship lines, which lapses at the end of 1925. By the proposed services, the time spent in travelling between Sweden and Finland, and, in consequence, between the rest of Europe and Russia, would be considerably reduced. Passengerswould leave Stockholm at 9.30 p.m. and arrive at Helsingfors 3.20 p.m. next day; or would leave Helsingfors at 3.40 p.m. and arrive in Stockholm at 7.15 a.m. next day. These times would make connections with the principal trains on both sides easy and convenient.

New Belfast Power Station.—In the account of the New Belfast Power Station, which appeared in our last issue, we omitted to state that the eight economisers working in connection with the Stirling boilers were made by E. Green and Son, Limited, of Wakefield.

Scholarships.—The following scholarships have been awarded for 1923–24 by the Institution of Electrical Engineers:—A Salomons Scholarship (value £50) to Mr. James Linton (Heriot Watt College, Edinburgh); and David Hughes Scholarships (value £50 each) to Mr. R. MacWhirter (Royal Technical College, Glasgow), and Mr. R. E. Banks (The University, Birmingham)

The Institution of Automobile Engineers.—The fourth annual dinner of the Institution of Automobile Engineers took place on Wednesday evening last, the 24th inst., when a large company of members, guests and ladies were present. The evening was a most enjoyable one in every way, and the note of optimism sounded by the speakers augurs well for the future of the British motor industry. Sir John Dewrance, President of the Institution of Mechanical Engineers, speaking on behalf of the senior body, congratulated the younger institution on its growth and the work it was doing. He said that although the two institutions covered, to some extent, common ground, there was room for a forward policy, and that he felt sure the Automobile Engineers had a great work to do in helping on British manufacturers. The President of the Institution of Automobile Engineers, Mr. H. G. Burford, referred to the important events which had taken place during the past few weeks. At Brooklands, in the 200 miles race, Major Harvey had achieved a fine record on the Alvis car. The engine, designed by Captain G. T. Smith-Clarke, was a splendid example of what British design, material and workmanship could achieve. With a capacity of 1496 c.cm. it had developed on test 57 brake horse-power at 4100 revolutions per minute. In the race a speed of 90 miles per hour was reached, and the success was largely due to the well-designed suspension and the excellent adhesion obtained, which allowed practically no slip. Another noteworthy event was the success of British light aeroplanes at Lympne. With a Douglas motor cycle engine of 750 c.cm. capacity an average speed of 76.1 miles per hour, with a gross weight of 460 lb., was attained. Such results showed that British designers and builders were capable of producing the very best, and they need not be afraid of the future. Sir John Dewrance had referred to the growth of the institution. In 1907 there were 302 members and this year 2030 members, but hundreds of automobile engineers had not yet joined their ranks. He appealed to the younger men to do so and so help to carry on the work which was being done. In outlining the programme of work undertaken by the Institution in connection with the Society of Motor Manufacturers and Traders, Mr. Burford instanced some of the important changes brought about by standardisation. The labours of Mr. T. H. Woollen had resulted in wind screen fittings being reduced from 70 sizes to 7, while wheel manufacturers were now prepared to construct wheels in 24 sizes instead of the previous 100 sizes. Dr. W. R. Ormandy—vice-president—proposed the toast of the guests, which was responded to by the Hon. Sir Arthur Stanley, the chairman of the Royal Automobile Club. Sir Arthur made reference to the work the Royal Automobile Club was doing and was prepared to do, in order to further the success of the British motor industry. The musical items, contributed by Miss Dorothy Burford and Mr. Franklyn Kelsey, were a pleasing feature in a very happy evening.

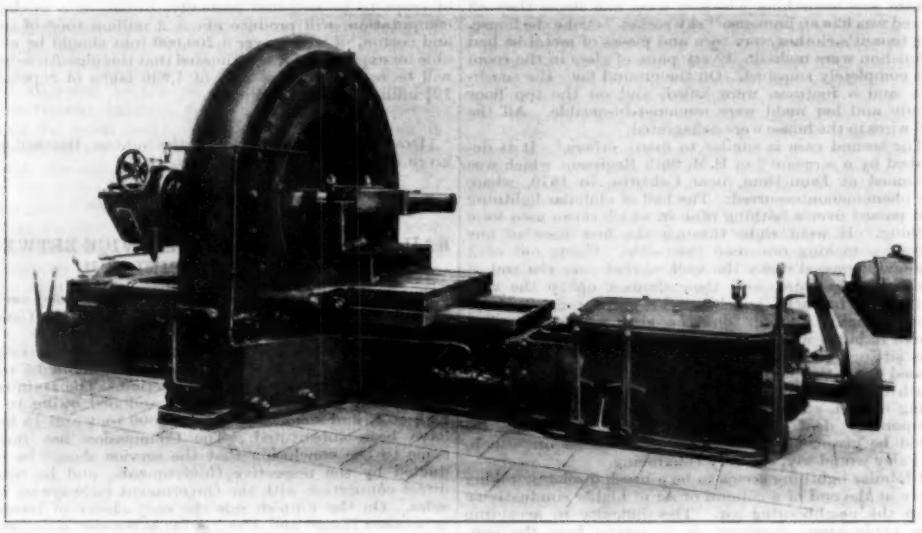
Crank Pin Turning Machine.

In turning the pins of large crank shafts in the usual manner, i.e., by causing the shaft to revolve as a whole, it is not easy to produce absolutely round pins and exact alignment of the pins and journals, owing to the difficulty of balancing the shaft when it is revolving. It is claimed that these difficulties are entirely surmounted by keeping the crank shaft stationary and causing the cutting tool to revolve round the job. We recently had an opportunity of inspecting an improved form of machine for this purpose, which has been built by Geo. Richards and Co., Limited, of Broadheath, Manchester, and which has been designed to deal with crank pins up to 12in. diameter made from square stock about 20in. across the corners and 24in. from the crank pin centre to the outside of the webs. Illustrations of the machine are given in the accompanying engravings. It will be seen from the half-tone engraving that the crank shaft is mounted in pillow-blocks, which are in exact alignment and secured to the tables in a solid manner. In machines of this size the tool used for turning the pin may be any long enough to cover the whole surface at one cut, are used.

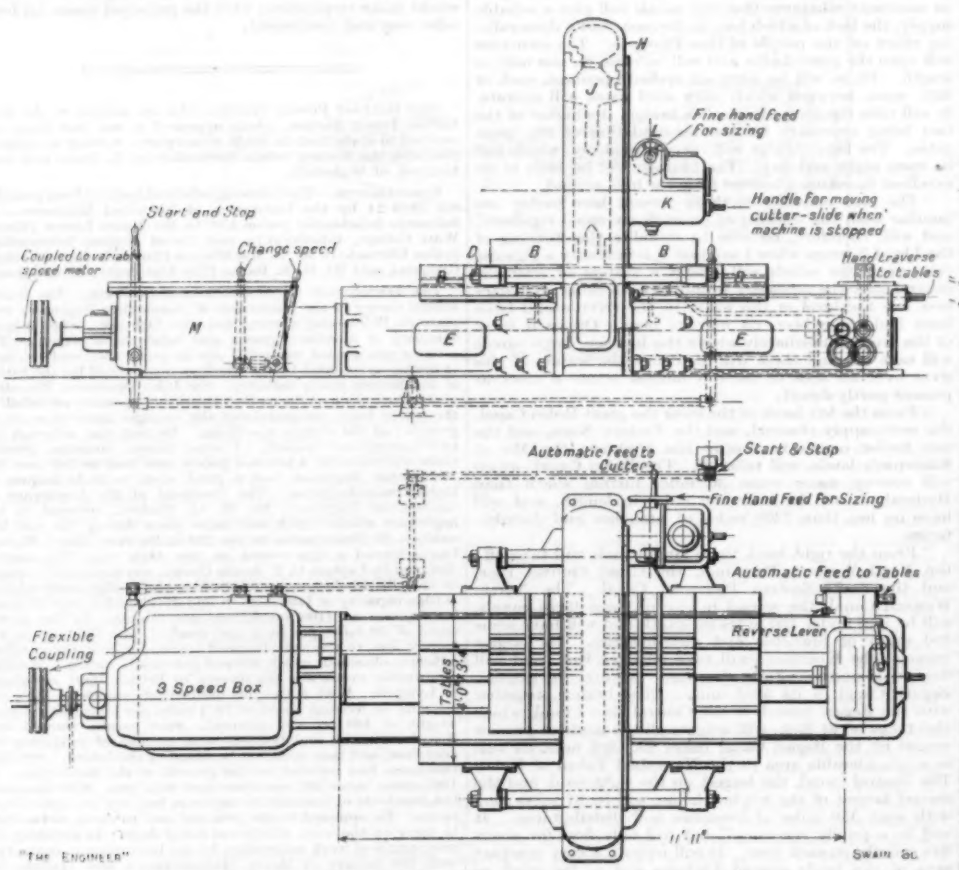
Referring to the drawing, A is the turning tool which revolves round the crank pin; B, the tables and packing pieces on which the pillow-blocks are secured, and C are slots in the tables for "locating" the pillow-blocks to the exact throw of the crank shaft by means of keys. The tables are locked together endwise by means of stay bolts D, and can be moved along the beds E by power or by hand in the larger size, or by hand only in the smaller sizes of machines. G is a forged steel slide which carries the turning tools for the front face and sides; H is the yoke carrying the revolving ring J, the latter having V-guides in which the tool slide G moves. The turning tool is moved inwards or outwards by power feeds from the feed box K, or by the hand wheel L. The revolving ring is driven by gearing in the three-speed gear-box M.

For mounting the shaft in the pillow-blocks, one roughing and one finishing bush are required for each diameter of crank shaft. These bushes are absolutely identical as regards their outside diameter. Several turning tools of different widths are desirable, although one tool will serve for various lengths by longitudinal movement of the tables and shafts. Two side tools long enough to cover the whole of web surface are also required for machining the inside surfaces of the webs. The tools are easy to make, being flat pieces of steel ground up.

The makers state that the machine illustrated will rough turn a 12in. pin from 15½in. stock in 75 min., at a cutting speed of 30ft. per minute, and machine the inside of the webs in from 10 min. to 15 min. Finishing turning requires, of course, considerably less time. The machine is made in four sizes, the largest size weighing about 22 tons.



RICHARDS CRANK PIN TURNING MACHINE



SIDE AND END ELEVATIONS AND PLAN OF CRANK PIN TURNING MACHINE

width up to 10in., so that in most cases the surface of the pin can be machined without moving the crank shaft endwise across the tool. The width of the tool and feed are, of course, regulated by the power of the motor employed to drive the machine, the 12in. machine being designed to absorb 30 horse-power. For roughing operations the feed recommended is .010in. per revolution, and for finishing cuts .005in. per revolution. For roughing out and finishing the inside surfaces of the webs, side tools,

Some Awkward Pipe Bends.

On the occasion of a recent visit to the works of the Millwall Engineering Company, Limited, at Glengall-road, Millwall, we noticed some large pipe bends of such a peculiar form that we asked the manager to have them photographed, and we reproduce two of the pictures herewith.

These bends were all made for fitting on some locomotives built to the order of the Spanish Government, and are noteworthy on account of their sharpness of curvature, lightness of gauge, and the high pressure at which they had to be tested. The material, in all cases, is mild steel.

FIG. 1

On account of their sharpness, it was obviously impossible to form the bends—shown in Fig. 1—by a bending process, and they were built up by acetylene welding, each bend comprising several short segmental shaped pieces. The pieces were cut to shape by means of the blow-pipe and tacked together, by welding, whilst being held in a jig. The joints were then filled in by acetylene welding. The workmanship of the welders was really excellent,

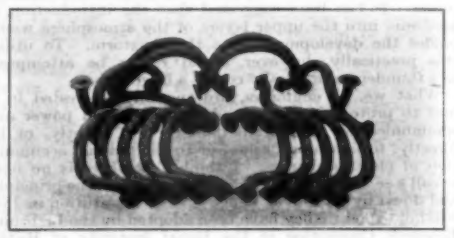


FIG. 2

and viewed from a few yards distance the joints could not be detected at all.

In the centre of the group shown in Fig. 1, there is one of the exhaust pipes. It is 210 mm. in diameter and only 5 mm. thick. The two ends, which were screwed eleven threads per inch, are set at an angle to one another. These pipes, like all the others of the order, had to be tested to a pressure of 500 lb. per square inch, and for that purpose master flanges were screwed on to the ends.

The pipes shown in the foreground and on the right of Fig. 1 are 140 mm. diameter by 5 mm. thick, and were also built up by oxy-acetylene welding. In this case the flanges are at right angles to one another. One of them is fixed and the other loose. At the fixed end the tube was expanded into a groove in the bore of the flange and welded at the back. Both ends were machined up with a recess to take a joint ring.

The bends, shown in Fig. 2, are of the same diameter and gauge as those last described, but did not need building up as the curves are easier. It was, however, necessary to take very great care in packing them with sand, before they were bent, on account of the lightness of the pipe. The ends of the pipe were screwed and fitted with flanges, square at one end and round at the other. The flanges were slightly recessed and the tubes expanded in, so that they got a good grip and formed a tight joint.

There were, altogether, somewhere about a hundred bends in this order, and they were inspected and tested by an independent firm of inspectors, on behalf of the Spanish Government, which only allowed a tolerance of 1½ mm. on all dimensions, while the angles between the flanges had to be precise. That all the pipes were passed speaks well for the workmanship, as it is, of course, very difficult to judge the allowance which must be made for contraction on the cooling of short, sharp bends like those under review.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Government Schemes.

The Government's announcement of its enterprises in relief of unemployment has created a much more hopeful tone in Midland iron and steel circles. The measures outlined are widely approved as a necessary pledging of public credit to meet the immediate emergency. The promised expenditure of fifty millions on new enterprises ought to go some distance towards revitalising trade. If the work is put in hand as promptly as Ministers contemplate it should at all events avert any increase in the sum of unemployment during the coming winter. The possibilities arising out of the Government's plans are considered to be great for South Staffordshire. A large percentage of orders is bound to come to works in the Black Country, as this area produces more of the material that will be required for the building of bridges than any other district. The large steel works will not be the only firms to benefit, for the hundreds of manufacturers of nuts and bolts, angles, joists, &c., will all receive their share of orders. In regard to the bridge building orders, it is pointed out that the aggregate of steel called for will not be large, in view of the fact that ferro-concrete is to be used. More importance, however, is attached to the railway development schemes and other enterprises which the Minister of Labour has outlined. There is already an inclination amongst steel users to place orders, in view of the comparative firmness of prices. It is just possible that if consumers regard this new enterprise as a sufficient stimulant to make prices really stable, railway and shipbuilding orders may be given out. An order for a single ship may easily call for as much steel as the whole of the bridges. It is well known that the railway companies have many millions of pounds to spend on the renewal of rail tracks, rolling stock, the rebuilding of stations, &c., and that the directors are only waiting for the assurance of reasonable price stability to place this business. Another factor which, it is expected, will influence the attitude of buyers and prevent them from holding back in the hope of cheap steel from the Ruhr is the straight hint given by Ministers of the Government in regard to German steel. Producers and consumers of iron and steel and manufacturers generally in the Midlands and Staffordshire are now awaiting the circulation of actual contracts on account of the promised enterprises.

Changes in the Iron and Steel Industry Foreshadowed.

Motor spirit as a principal product and pig iron as a by-product of blast-furnaces was a prospect foreshadowed by Mr. F. J. Cook, of Rudge Littley, Limited, West Bromwich, the president of the Staffordshire Iron and Steel Institute, at Dudley, on Friday last. The economic side of the industry, he said, was of vital importance, and much larger advantage ought to be taken, with a view to profitable production, of what were usually termed by-products. Great strides had been made in the use of blast-furnace gases, but as regarded residuals, much greater profit could yet be realised. It was within the range of possibility that some day not far distant the residuals would be the primary object of blast-furnace operation, and pig iron would be considered the by-product. The capabilities of the blast-furnace as a source of motor spirit had been hardly yet realised, but in that direction a wide field of opportunity was gradually opening up. The modern motor car had been made possible largely through the production of high quality steel and other metals, and it would be a kind of reciprocal justice if the motor, by using largely petrol or some other spirit produced from the blast-furnace by-products, should be a source of strength and profit to the iron and steel trades.

Birmingham Engineers and Emigration.

The Birmingham District Committee of the Amalgamated Engineering Union has written to the Ministry of Labour, the Board of Guardians, and the local Employment Committee with reference to those of its members who, being unemployed, are desirous of leaving the country for some other country where work can be found for them. It has asked whether assistance can be given by grants from the fund referred to by Colonel Buckley, Parliamentary Secretary of the Department of Overseas Trade, at the Imperial Economic Conference on October 5th.

The Pig Iron Situation.

Ironmasters in this area, on the strength of the assurance given that development work is to be vigorously pushed forward, are taking a more optimistic view of the situation. Prices are firm all round. Consumptive demand was on a slightly improving scale before Ministers made their announcements, and to-day—Thursday—on 'Change in Birmingham orders for 50 or 100 tons were given out in some cases where buyers would not have ventured beyond 25 tons last quarter. Prices of Derbyshire and Northamptonshire iron are practically unchanged, but smelters, now that Cleveland has given them a lead, will take the earliest opportunity to raise their prices in view of the unprofitable character of business. Pig iron producers are warned, however, to make haste slowly in the matter of balancing production costs and selling prices. The present view of buyers is that equilibrium must be sought by way of cheaper raw materials and labour and by the savings which an increased output makes possible, not by an advance of selling prices. The temptation not merely to redress the balance, but to exploit a market advantage without regard to the inevitable reaction, generally proves irresistible. That was what the smelters did at the opening of the year, notwithstanding the heavy penalty they had just paid for the excesses of the boom. If the tide turns now, furnace owners will naturally expect that the industry should be put on a profit-earning basis. Until demand increases very much more than there is any promise of at present, labour and raw material costs will be swollen out of all proportion by abnormal dead charges. Hence cheap pig iron is not within the range of possibility. It is to be hoped, however, that the rehabilitation of the industry will be sought through the cutting down of costs, not by the inflation of selling prices. Not so long since many of our mills, forges, and foundries were driven to buy their raw material abroad in order to keep any sort of footing in the market. Coke is easier so far as supplies are concerned and some of the Durham cokes are cheaper.

Improvement in Steel.

In the steel department a buying movement appears to have re-started. Several three months' placements have this week been offered to certain large steel concerns, and this is regarded as a hopeful sign. A large Black Country firm of steel masters states that during the past week or so there has been a decided improvement in buying. It is not attributed by the firm to any one cause, but it considers that the Government's policy and the fact that consumers are getting tired of waiting for prices to come down has something to do with it. Structural steel inquiries are much more numerous throughout the Midlands, and though the proportion of business which has accrued is not large thus far, the outlook is considered to be decidedly more hopeful, and this is reflected in the steadiness of prices. In the small steel bar trade values have increased fully 5s. per ton, £9 10s. now being the minimum, and many re-rollers demanding £9 15s. The demand for billets has encouraged the withdrawal by many firms of the £7 15s. figure, and £8 is now generally quoted. A feature of the steel position is the general refusal to accept contracts beyond the end of the year. It is now revealed that some of the orders lately placed have been speculative, and specifications, when called for, are not forthcoming. Manufacturers do not encourage this kind of buying. Hardly any quotations have been received this week from the Continent, and the few arriving have almost invariably been well above native prices. For semi-finished steel this country can now undersell the Belgians, and certain Birmingham merchants are at present offering quotations to Belgians, which it is thought may lead to business.

Finished Iron Trade.

Hardly any change for the better is discernible in the manufactured iron industry in South Staffordshire. Makers of best bars still find it easy to maintain the £14 10s. figure, although the gap between this and common iron selling at £11 10s. is unusually wide. No. 3 Belgian iron continues to be the chief competitor with nut and bolt bars. But the price of this has advanced somewhat, recent quotations being £9 2s. 6d. and £9 5s. delivered in this district. This price, however, is more than 30s. below the Staffordshire figure, and consumers consequently —though their demands are small—are satisfying them whenever possible from the foreign source. The Darlaston area expects to benefit from the bridge-building programme of the Government, in view of the large quantity of nuts and bolts likely to be called for. The possibility of a settlement of the boilermakers' dispute and a renewal of activities at the shipyards as a result is also regarded as a hopeful sign by nut and bolt manufacturers hereabouts.

Galvanised Sheets.

The galvanised sheet trade continues brisk, with substantial orders on the £19 basis. The mills rolling thin gauges have orders on hand sufficient to occupy them until next spring.

Staffordshire Miners' Wages.

The wages of miners in the Staffordshire coalfields during the months of November and December will remain at the minimum rate. They have been on this scale since June, 1922.

Midland Workless.

A further and more substantial fall in the number of persons out of work in the Midlands is recorded in the latest returns. The total number of workless is given as 166,848, a decrease of 1275 as compared with the figures for the previous week. In Birmingham there has been a decline of 295, the number falling to 42,048. The total figures are distributed as follows:—Men, 121,504; boys, 3967; women, 36,116; girls, 5261.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Situation.

There seems to be a slight improvement here in regard to the feeling in the iron and steel markets, although this does not extend to the non-ferrous metal markets. One cannot say that any definite strengthening of prices is to be noticed yet, although it is possible that there is less disposition to make concessions. The fact is that almost all the prices are down to costs, and that any concession means a loss to the manufacturer, and is made only because the stoppage of the works may involve a greater loss. Hence, so soon as the slightest indication of improvement—or even the hope of it—occurs, concessions are withdrawn. The outlook is, of course, very uncertain, for there is no means of knowing whether or not the German siderurgical industries are to come to a full stop, or whether the French will succeed in getting them going again, and the future of our iron trade prices is largely dependent upon this matter. There is, however, very little doubt that if iron and steel prices are to be artificially stimulated, the effect on our own industries will be bad; for it is certain that, in the interests of engineering and shipbuilding, lower and not higher prices are wanted for all the material.

Metals.

The feeling in the copper market is still very depressed, and both consumers and merchants here take the pessimistic rather than the sanguine view of matters. It is, of course, admitted that copper prices are unreasonably low; but so far the low prices do not seem to check the American production. American producers—if their public utterances are any proof of their private convictions—still believe that things will come right, and that the demand for copper will soon be larger than it ever was. One of them is reported as saying that "the outlook for business next year is brighter than it has been for years." Such an idea seems very inconsistent with what we know of the industrial condition of Europe. The real situation in copper is reflected in the prices, and not in the optimistic speeches of American copper magnates, with whom the wish is apt to be father to the thought. There are reports that American domestic consumption of copper is declining, and with smaller consumption in Europe, the actual statistical position of the metal is getting worse rather than better. Very little change in the prices, either of refined or of manufactured copper, has occurred during the week. It may be argued from this that the prices are about as low as they can go, at any rate for refined metal, but merchants here do not seem to be very sure on that point. There is, however, not much risk now in holding stocks of copper ingots, and probably the reason why consumers hold so little is because they have not much work in prospect. Tin has been rather a stronger market of late, partly because some American buying has occurred, and partly because of the better demand from the Welsh tin-plate industry. The latter business has been more active of late, and, compared with most of our metal industries, it is in quite a flourishing condition. The market for lead has again been exceedingly firm, and prices have continued to creep up. Consumption in the cable-makers' industry seems to be one of the principal supports of the lead market. An advance of £1 per ton has been announced in pipes and sheets. Spelter is also a stronger market, and there has been some considerable improvement in the volume of demand.

Pig Iron.

The markets in Lancashire for foundry pig iron are, if anything, a little steadier and stronger than they were. It may be doubted whether there is more than a slight improvement in the prices, but there seems to be rather less disposition to take orders for Derbyshire No. 3 on a basis of below 91s. per ton at the furnaces. The opinion of consumers seems less pessimistic than it was; and although there is not yet very much forward buying, this movement may certainly come if consumers give up the hope of lower prices this year. One reason for the abandonment of this hope is no doubt the firmness in the market for furnace coke. On making inquiry one finds that it is not at all easy, even if it be sometimes possible, to buy furnace coke at less than 26s. It is said that in many cases blast-furnaces in need of coke have to pay rather more than less than the old price of 26s.; and in this case the claim of consumers that pig iron ought to be cheaper falls to the ground. The possible establishment of a separate and stable Government in the Rhineland gives promise of the return to better industrial conditions in that district; but it would take a long time to resume the normal production of fuel and iron, and meanwhile there is a probability that the Continent will need to import British fuel, if not British pig iron. The price of Scotch iron here is now 117s. 6d. per ton delivered, but there is very little buying, and many ironfounders are using substitutes.

Steel.

The slightly improved feeling in the steel trade is no doubt caused by the hope that some large orders for constructional and railway steel will soon be given out. Shipbuilding work is still held up by the boilermakers' dispute, but it is said that there is a fair amount in the way of repairs waiting to be done. The prices here for finished steel are practically as they were, viz., £9 5s. per ton for joists and angles, and £9 15s. for plates; but there is less disposition to cut these prices, and an advance is expected. Reports as to orders for new ships are not promising, and some people say that the outlook in this respect is worse than it has ever been. The export trade in steel is thought to be better, but it is not yet good for heavy steel.

Scrap.

There is at last some sign of improvement in the scrap market. For a long while prices have been unreasonably low; but just now, both in steel and in cast iron, there is a slightly better demand. In Lancashire heavy steel melting scrap had fallen to 60s. per ton, or, at any rate, that was the price dealers were offering for it, but recently up to 67s. 6d. and even 70s. per ton has been paid for the scrap at stations in Lancashire. The reason is that Sheffield buyers are acting more freely, and paying better prices. The demand from founders for the finer qualities of cast scrap is better, and one is inclined to attribute this to their desire to avoid paying high prices for Scotch pig iron. At any rate, up to 90s. per ton has been paid for good lots of cast metal. In heavy wrought scrap there is no improvement yet.

BARROW-IN-FURNESS, Thursday.

Hematite.

It would seem that the depression in the hematite pig iron trade is really over, though the improvement, noticeable as it is, is slow. It is, however, much better that there should be progress in that way rather than there should be a sudden spurt and then a fall back. The Midlands trade is improving, and there is also more iron going to Scotland, but as for any booking of orders for forward delivery, there is not much to say as yet. Better confidence prevails, and there are evidences that in a few months there will be a brighter state of things. Prices are competitive, with not much margin. The possibility of an improvement in the steel trade in the next few months adds to the impression that more furnaces will be put in in due course, but makers in the meantime are proceeding with caution, and there will be no rushing in to increase output until the conditions actually dictate such action.

The American trade shows signs of improvement, and there are shipments across the Atlantic of Bessemer numbers.

Iron Ore.

The iron ore trade is little different as yet. Some mines are doing little and not keeping their hands anything like fully employed, but with the prospect of better business in iron, the hopes of bigger outputs of ore are brighter. The same remark applies to the business in foreign ore. Requirements as yet are limited, and the imports are not heavy nor likely to be for some time. Anyhow, stocks still exist at West Coast ports.

Steel.

The prospects in the hematite steel departments are better. Orders booked a few weeks ago will keep the Barrow rail and merchant mills going for a few weeks, and as more orders are possible there is a chance of these mills keeping on. At Workington more orders are likely and they will help to fill in the gaps created by the Gold Coast order, which keeps the rail mill engaged for one week per month, the deliveries being spread over a period. There are hopes that in a few months the steel trade will have generally expanded. The market is brighter already. The foundries are moderately employed, and the section and hoop mills at Barrow are still experiencing activity.

Engineering.

The booking of the order for three 7500 horse-power water turbines by Vickers for Winnipeg will provide work for many. This department at Barrow has developed, and already some heavy machinery of this class has been delivered to India, New Zealand, &c. Activity is now in evidence on the Admiralty work which was placed at Barrow with a view to providing jobs for the unemployed. This is principally reconditioning gun mountings, &c. It is understood now that some of the London, Midland and Scottish steamers—probably the Heysham and Fleetwood service boats—will be laid up in the Barrow docks and be overhauled there. This will mean a development in engineering business in the long run. The late Furness Railway engine shops are now dealing with repairs, &c., of locomotives over a bigger area, as the West Cumberland stock is being reconditioned in Barrow now. Several locomotives and carriages of the Furness section of the London, Midland and Scottish Railway have been repainted in the new company's colour. The locomotives are a little darker than they used to be, and the carriages are now the well-known Midland lake colour.

SHEFFIELD.

(From our own Correspondent.)

A Revival of Confidence.

The position of the steel trade remains practically unchanged, except for a few departments. Those engaged in the manufacture of open-hearth billets report that, although they have enough business on hand to keep them working up to a fair amount, there is no increase in the placing of new orders, and they are far from being busy. This applies both to basic and acid steel, more especially to the latter. But the feeling of optimism, which has never wholly disappeared during these difficult times, is now stronger than ever. It is based largely on the belief that the railway companies are at last about to give out some really large contracts for construction and renewal work which is long overdue. When this comes about, Sheffield will no doubt receive the bulk of the orders for tires, axles, springs, and other rolling stock parts. The plants for the making of these necessaries are on a huge scale, those for tires having been doubled since pre-war times. At present, although there is considerable work on hand, a good proportion of the equipment is idle; but if the orders materialise, on the scale that is anticipated, they will provide enough work fully to employ all the city's resources in this direction and to keep them busy for several years. The railway orders will also be of great benefit to the tool trades, as the building of locomotives will call for large quantities of files, tool steel, tools, and various cutters. In this latter respect, too, the bridge building programme will be of advantage to Sheffield, although the city will not have much share in the actual constructional work, as the steel required is not such as is made in any quantity in this district.

The German Steel Stocks.

Those engaged in the steel trade are watching, and watching with rather varied feelings, to see what will be done with the two million tons of steel which are reported to be lying in the Ruhr, ready for release. The question of the dumping of this material presents itself differently to different interests. It would be a serious blow to those great works at Templeborough, Parkgate, and Penistone, which have laid themselves out for an enormous production of billets, to meet the requirements of the finished steel manufacturers of the country. On the other hand, cheap importation would assist many of the rolling mills, while the shipbuilders are strongly in favour of it, on the ground that it would enable them to book orders which they cannot obtain otherwise. The position raises the old remark that what is one man's finished product is another's raw material, and the old difficulty of knowing where to draw the line in the matter of foreign competition.

Tool Steel and Files.

The position of the tool steel industry is not much altered. The crucible furnaces are poorly off for work, and much of that which comes in is of small dimensions, the orders being placed with a view to meeting immediate requirements only. The file factories are working to about three-quarters of their total capacity, and the existence of idle plant, coupled with severe competition, is rendering the trade the reverse of profitable. The Admiralty is asking for about 13,000 dozens of files for next year's supplies. This quantity is only about half of what was customary in the days of big navies. Deliveries under the contract will be spread over a long period, so that the situation in Sheffield will not be materially affected. The trade, although far from satisfactory, is in a much better position than it was a year ago.

Cutlery and Plate.

Makers of cutlery report some improvement on the week, and more is expected, for the present month and the next two are generally the busiest of the year. The outstanding features of the overseas department are the large shipments to Australia and New Zealand. In September Australia took more than a third of the whole of Sheffield's cutlery exports, and it is doing correspondingly well in plate, tools, and other steel products. The silver and electro-plate trades also report a better situation. Full time is being run by firms which supply raw material and blanks to the manufacturers, which shows that the aggregate production is not very far short of that of normal times. A very large trade is being done in spoons and forks, but some well-known firms, while making no complaint as to output, are suffering from the unremunerative nature of the work. The more expensive classes of hollow-ware are not in such good demand, and many instances of slackness are to be found. Since the war there has been a considerable increase in the number of plate-making firms, so that a much larger total amount of business is needed if all are to be kept in fair employ.

New Stain-resisting Silver.

"Silanca," a new stain-resisting silver, the introduction of which I noticed a few months ago, has now been brought before the manufacturers of America and the United States, and has met with a good reception. Messrs. Harold Turner and J. C. Bennett, who have put the material on the market, have just returned from a visit to those countries. They report that they found the Americans eager to discuss the new material. Specimens of finished plate made from it were on view at the International Exhibition at Toronto, and much interest was displayed in them by many American visitors as well as by the Canadians. One of the specimens shown presented a bright untarnished surface, although it had not been polished since it was made two years ago. The Canadian plate firms are experimenting with the new metal, and the specimens, on leaving the exhibition, were sent into the United States to enable the trade there to study them.

A New Lead Discovery.

The interest which has recently focussed on the old lead mining industry of Derbyshire in consequence of the reports of its revival from a moribund state is likely to be increased by the news of the discovery of a virgin ore of lead at Wenslees, near Matlock. It is the first virgin vein recorded for half a century. In accordance with the unique laws governing the industry, the vein has been "given away" to the discoverers by the Barmaster, who represents the King for the Duchy of Lancaster. There are two shafts, separated by half a mile, one of them being known as the Half Acre and the other as the Caergwyrle. The vein has panned out one of the richest on record, and the prospects are excellent, as the vein is in the same lead ore area as the famous Mill Close Mines. The measure of ore taken by the Barmaster gave 63 lb. and 64 lb. to the "dish," which is remarkably rich. The King takes a ninth of every "dish" as his fees.

New Railway Wagon Works.

The building and repair of wagons is to be commenced at an early date at Finningley, near Doncaster, by a Leeds firm, which has acquired the works that were vacated by the Sheffield Simplex Company when the manufacture of that firm's special type of motor bicycle was transferred from Finningley to Kingston-on-Thames.

Railway, Dock, and Road News.

In connection with the sinking of Harworth Main Colliery, near Doncaster, where the Barnsley seam is expected to be reached in a week or two, the South Yorkshire Joint Line Committee has just accepted, out of twenty-three offers, the tender of Mitchell Bros., Sons, and Co., Ltd., of Glasgow, for £106,506, for the construction of a new line to the colliery from Tickhill, a distance of about four miles. The people of Grimsby are looking forward with much interest to the possibility of the construction of their new fish dock being commenced this winter. The directors of the London and North-Eastern Railway Company have considered the scheme in London, and there has also been a meeting of the officials of the railway company and of the dock. The scheme was deferred when the war broke out, but there is great hope that it will be put in hand to cope with the unemployment problem this winter. It will cost between £2,000,000 and £3,000,000, and will provide a dock with a greater water area than the existing fish docks, market space twice as large as that now existing, and sidings and hoists for the rapid coaling of ships. At Hull a start is to be made shortly with a new town-planning scheme, by which a dilapidated slum area will be replaced by a fine shopping road, 120ft. wide, from Paragon Station to Beverley-road. The new thoroughfare will cost £150,000 and will include an omnibus stand and a motor park. Leeds, which already has in progress relief schemes costing £700,000 and employing 5000 men, is proposing to embark upon further schemes representing an expenditure of £730,000, which will absorb 5000 more men. The new schemes include the extension of the Moortown covered reservoir, at an estimated cost of £34,000; construction of new sewers, £100,000; new roads, £70,000; widening existing roads, £80,000; tram track works, £46,681; and light railway works, £100,000.

Engineering at Collieries.

At a meeting of the Midland Institute of Mining Engineers, held in Sheffield last week, Sir William Ellis, president-elect of the Iron and Steel Institute, read a paper on "The Position of Mechanical Engineering in Colliery Operations," in which, pointing out how greatly colliery work had developed during the last twenty-five years, he contended that the time had come when a mechanical engineer of wide and technical training should be included amongst the staff of a colliery, and should have given him a status higher than had been the custom. Several of the engineers present expressed the opinion that, while the suggestion might be adopted with advantage at large collieries or groups of collieries, it was not possible for the smaller firms. At the same meeting Mr. Douglas Hay, Professor of Mining in the University of Sheffield, referred to the necessity of modernising the equipment at old pits, and the difficulty which many firms found in securing the necessary funds. He put forward the interesting suggestion that some of the public money which is now being devoted to the relief of unemployment should be allotted to collieries for the purpose of enabling them to bring inefficient plants up to date. He said the work would be so productive that the collieries could afford to pay a fair rate of interest on the money. If this were done, many pits that were now closed down would be enabled to work at a profit, and the country would benefit in many ways.

NORTH OF ENGLAND.

(From our own Correspondent.)

Pig Iron Boom.

A somewhat sudden revival of demand in the Cleveland pig iron trade has been followed by sensational developments in the market this week. There has been quite a rush of inquiries and orders, and the volume of business, both on home and foreign account, has reached gratifying proportions, with the result that stocks have been liquidated. There is now, in fact, very little pig iron on offer, and those merchants who have sold without cover—and there are believed to be not a few, chiefly in Scotland, who have done so—will find themselves in a rather difficult position. The fact that the great bulk of the increased demand for iron comes from Scotland supports the view that some have been selling beyond the Tweed without cover, for there is no marked improvement in the industrial situation as yet, and it remains to be seen whether this improvement will come in time to sustain the higher prices now ruling. This week the standard quality, No. 3 Cleveland pig iron, has been advanced by 3s. 6d. per ton to 100s., and the other qualities in proportion, No. 1 now being 107s. 6d., No. 4 foundry 99s., and No. 4 forge 88s. Whilst the producers have for some time past been deploring the fact that quotations were unremunerative, and have been hoping for relief in the direction of cheaper working expenses and some little improvement in market prices, they agree that violent fluctuations such as the one experienced this week are detrimental to legitimate trade, and fears are entertained that the rapid rise will nip in the bud the indications of expanding business. It will certainly limit the sale of Cleveland iron in the continental markets, and the competition of Midland iron, which had been virtually eliminated, may be renewed.

Hematite Pig Iron.

There has been a better inquiry for East Coast hematite pig iron, but no great rush of orders, such as have been received by the Cleveland iron producers. However, the improvement in foundry iron is found to affect favourably the hematite trade, and especially as the latter is now the cheaper. For some purposes hematite can be substituted for foundry iron, and may again be so substituted. Mixed numbers are still obtainable at 99s. per ton for home consumption and 99s. 6d. for export, with No. 1 at 6d. per ton premium.

Iron-making Materials.

Now that shipments from Bilbao have been resumed there is some pressure to sell best Rubio ore, but owing chiefly to cheaper freights, Mediterranean ores are still the cheaper. There is, however, very little demand for foreign ore, and best Rubio remains nominally at 23s. per ton c.i.f. Tees. Coke is firmer, though some of the producers hesitate to exploit the situation, and are still prepared to supply their ironworks customers at 39s. In other cases, however, 40s. per ton delivered at the works is now the quoted price.

Manufactured Iron and Steel.

More encouraging accounts are given regarding the manufactured iron and steel trade. There is a growing volume of inquiry for steel, both from home buyers and also for shipment abroad, and not merely inquiries, but orders. Quite a number of contracts have been placed, and the works on the North-East Coast are all a good deal more favourably situated than was the case a few weeks ago. This improvement is entirely independent of the shipbuilding trade, and if peace be restored in that industry there will be busy times ahead for the steel trade. Although there is no alteration in the list of quotations for manufactured iron and steel, there is a perceptible stiffening all round.

The Coal Trade.

The improvement in the Northern coal trade is well maintained. There have been numbers of forward bookings for next year's shipment. Some of them have been purely speculative, and some against definite business, and amounting in the aggregate to fairly large totals. Most of the coal fitters report themselves well sold ahead, and are quite convinced that the present range of prices will hold over the rest of the year. At the moment, however, business for next year on the part of merchants has subsided, there being a disposition to hold back and wait developments before booking up further. The outlook, it must be admitted, is by no means clear, for while there are some who take a most optimistic view of the forward prospects of the market, there are others who think that the present situation is fictitious and unstable, and must inevitably be followed by a smart reaction, if not a slump. The prompt market is generally very steady, though the individual position of some of the collieries is a little awkward through the lack of wagons and trucks, and by the dropping out of turn of some of the stemmed

tonnage. The export section of the trade has assumed a quieter aspect, so far as new business is concerned. The conditions in mid-Europe are not calculated to inspire much confidence, while from Norway and Sweden the inquiries are limited. This applies equally to France and Italy. Shipments, however, against previous contracts are heavy, and the loading turns well filled. The Northumberland steam coal trade is in a strong position, and for any of the well-known brands of screened steams, both bests and seconds, there is a ready and firm market. Smalls, however, are plentiful and are easy. So far as the Durham market is concerned, there is a lull in business. The disposition now seems to be to hold off until the tendency of the gas coal market can be more definitely gauged than is possible at present. There is, however, no alteration in prices from last week. The coke trade is generally steady, though a shade quieter for foundry kinds, while gas coke is well supported by a growing inquiry.

Shipbuilding and Engineering Contracts.

Several important contracts have been placed this week with Northern shipbuilding and engineering firms. Sir Walter Runciman and his son, Mr. Walter Runciman, have placed orders for new steamers with North-East Coast shipyards, in advance of the programme of their firm. The work on these vessels, and on the engines and auxiliary machinery, is to begin as soon as the boilermakers' dispute has been settled. Two of the vessels are to be built on the Wear and two at Blyth. They are in addition to the vessels already under construction on the Tyne to the order of Messrs. Runciman for their Moore Line, all the work on which is suspended owing to the boilermakers' dispute. The Cleveland Bridge and Engineering Company, Darlington, has received an order from the Wallasey (Cheshire) Town Council to construct a ferry landing-stage at Seacombe, a condition being made that all-British steel must be used. The firm's tender for the work was £55,293.

SCOTLAND.

(From our own Correspondent.)

Continued Scarcity of Business.

So far as the main industries are concerned, there has been little, if any, improvement during the past week. Markets remain dull and featureless, and the outlook is still overshadowed by the position in the shipbuilding industry.

Steel and Iron.

The situation at the steel works is still most unsatisfactory. Makers find great difficulty in securing fresh orders against home as well as foreign competition, despite a keen cutting of prices. Inquiries have increased a little, but local works are not obtaining much of the business in circulation. Orders for plates and sectional material are especially scarce, and only a very small proportion of the plants is in operation. Home prices show no change, while export quotations are of a very fluctuating nature and almost impossible to ascertain with any degree of accuracy. The export turnover in steel sheets is comparatively well maintained, and this supplies one of the few bright spots in the industry. The demand, however, is still largely confined to the lighter gauges, and producers would welcome an increase in heavier sheets. The amount of business received at the bar iron works is of very small bulk, though a slight increase in export inquiries is mentioned. The home price for Crown quality bars is unchanged, while export can be done about £11 to £11 5s. or even under, the lower figure for a good order. The prospect of easier prices has brought out increased inquiries for re-rolled steel bars and some fair orders are in view. The pig iron market is dull, but in this department also inquiries indicate better prospects. Hematite is fairly firm, and foundry qualities practically remain unaltered from last week.

Coal: Scarcity of Prompt Supplies.

The Scotch coal market presents a firm attitude, and there is a possibility of further increases in prices of round fuel. Lanarkshire ells and splints have been heavily booked for early shipment, and steams have a good number of orders also. Lothian and Fifeshire steams are also comfortably placed for about two weeks ahead. Buyers have shown little inclination to realise requirements for longer periods than ten days to a fortnight ahead, but just at present there is a number of inquiries for the end of November and the beginning of December. In all districts a fairly regular market is found for washed nuts at current prices. Aggregate shipments are somewhat smaller. The East Coast ports shipped less coal to Germany, the bulk of the cargoes going to Belgium and North France. Aggregate shipments for the past week amounted to 324,356 tons against 340,763 tons in the preceding week and 290,910 tons in the same week last year. The home market for coal is somewhat busier, owing to increased demands for household and general utility purposes. Dearer prices for coal have had little effect on the house coal demand, best qualities of which are particularly busy.

Work for Renfrew.

It has been reported that the shipbuilding firms in Renfrew have recently secured some orders, and will be able to give employment to a large number of workmen as soon as the boilermakers' dispute is settled.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

On the whole there has not been a great deal of change in the general position regarding the steam coal trade during the past week, and the conditions, so far as prompt business is concerned, leave much to be desired. At the same time the outlook is slightly better, and certainly coalowners are more hopeful that before very long continental consumers will be in the market for supplies of coal for fairly early delivery, in view of the fact that their prospects of securing coals under Reparations deliveries are now much more remote than they were a week or two ago. Undoubtedly buyers in France, Italy and Belgium have been holding off in the hope that there would be no necessity to come to this district for supplies, and under this influence and the "bear" tactics usually adopted at this period of the year, in view of the arrangement of contract supplies over next year, the market has naturally suffered, and prices are lower now than they have been for many months past. There is also this factor which induces coalowners to look for better conditions in the near future, and that is that there is some prospect of steel works becoming more active, and, of course, this would mean an improvement in home consumption and a corresponding reduction in the quantity of coals available for export. At the moment, however, inquiries are very restricted, but the Norwegian State Railways are in the market for 25,000 tons of best Admiralty large double-screened coals for shipment over the next two months, and there is also an inquiry for 20,000 tons of Monmouthshire coals for the Sudan Railways for delivery over the same period.

Coal Contracts Over 1924.

Since writing a week ago, a fairly substantial amount of business has been done in coals for delivery over the whole of next year. Taking advantage of the steady fall in the market for current supplies, no doubt many merchants and consumers have formed the view that the time was favourable to making their arrangements for coals next year. Naturally a good deal of secrecy is observed as to the actual amount of business done, but that it runs into hundreds of thousands of tons is not doubted on the market for one moment. In the case of one large and important undertaking producing a very good brand of second Admiralty large coal, it is reported that business to the extent of several hundred thousand tons alone has been done at the price of 26s., while it is known that one of the collieries supplying one of the best Admiralty large has sold on the basis of 27s. 6d. over the whole of next year, and that it has now closed its books, it being its intention not to sell any further coals at this figure for delivery ahead. Their price is now 28s. for any further contract business over 1924. Superior second Admiralty large have been contracted for at 27s., and best Monmouthshire large have been done at 26s. 6d. to 27s. In most cases, the prices paid for supplies over next year closely approximate the values now ruling on the market for current cargoes, but at the same time they are an advance of practically 1s. per ton upon those paid during the contracting season last autumn, and the reason for the firm declining to do business unless it secured this increase is the fact that its costs, more particularly in respect of wages, are pretty certain to be higher. So far, comparatively little business has been concluded ahead in respect of anthracite coals, but it is especially interesting to see that the firm of Llewellyn, Merrett and Price, Limited, of Cardiff, has sold from 100,000 to 150,000 tons for shipment to New York and the New England States over the period from now until the end of June next. This business has been secured by Mr. H. H. Merrett, one of the partners of the firm, who has been on a visit to the States and is now on his way home. The coal which will be shipped will be machine-broken cobbles and nuts. It is noteworthy that the orders for this coal have been obtained from people who have previously purchased anthracite coals from this district, so that being repeat orders they are the more interesting, as showing that the purchasers are satisfied with the quality of Welsh anthracite. The same firm is also shipping fairly large quantities of anthracite to Canada, and already has business in hand for shipment next season when the St. Lawrence River reopens.

Loading Hours.

For some considerable time past shipowners have had a very difficult time, in view of the unremunerative character of freight rates ruling, and it is not surprising in the face of the delays which have been experienced at loading ports and the costs which these have entailed, that there should have been an agitation for a reduction in the scale of loading hours at South Wales ports contained in the South Wales coal contract form. It looks now very much as if something definite will be done to secure a revision of the scale hours existing. At the moment what are known as colliery scale hours are 6 per cent. for the first 2000 tons cargo and 4 per cent. for the balance, so that for a steamer taking 4000 tons cargo, the loading hours would be 200 hours. Shipowners, and in a lesser degree coal exporters, consider hours on this scale as excessive, and the scale which has been approved by the Documentary Committee of the Institute of Chartered Shipbrokers, is 2½ loading hours for each 100 tons beyond 1500 tons, as against 3 hours per 100 tons above 2000 tons, which has been offered by the coalowners. Representatives of the shipbrokers and coal exporters have this week had a meeting at Cardiff to consider the position, and there is to be a further meeting next week at which representatives of the coalowners will be present; but whatever agreement is come to respecting what should be regarded as colliery scale hours, it is practically certain that actual hours of loading agreed upon as between the charterers and shipowners or shipbrokers will be dictated largely, if not entirely, by the supply and demand for tonnage.

Ship-repairing Work.

The ship-repairing industry in this district continues to be rather on the quiet side, but lately the Mountstuart Dry Docks and Shearmans, Limited, Cardiff, have secured two important orders for the repair of the ss. City of Shanghai and the ss. Deputé Maurice Bernard. The latter steamer stranded on Breaksea Point a fortnight ago, and it is interesting to note that Mountstuart Dry Docks and Shearmans, Limited, obtained the order, not only by reason of having tendered the lowest price, but by undertaking to do the work in the shortest time. Their tender was £7750, and they undertook to repair the steamer in thirty days, which compares with the highest tender of £9685 and forty days. The repairs include the renewal of fifty-six bottom plates, and the cutting, fairing and replacing of twenty plates. Practically the whole of the frames and floors will have to receive attention, while the stern frame, which was broken in two places, will have to be renewed.

Threatened Closure of Colliery.

With regard to the decision of the owners of the Nine Mile Point Colliery to close the colliery at the end of the present month on account of the fact that they could not make it pay, interviews between the management and the representatives of the South Wales Miners' Federation have taken place, and as the result of the discussions the owners have decided to continue the working of the pits for an extended period of a fortnight, in order that further negotiations can be conducted and the closing of the colliery avoided.

Current Business.

The tone of the steam coal market continues to be very quiet, and there is not much business about for prompt loading. The tonnage position is also not very satisfactory for many collieries, and the consequence is that values are irregular, and for spot shipment colliery owners are compelled to make concessions in order to obtain the release of wagons. Best Admiralty large have been easily obtainable at 27s. 6d., and second qualities at 26s. 6d., and even lower. Monmouthshire large coals have also ruled about the latter figure in the case of the superior descriptions. Supplies of smalls have rather increased, and the result is that best grades command no more than about 18s. to 18s. 6d. The inquiry for patent fuel shows no expansion. Anthracite coals are somewhat quieter as regards large coals, but for sized qualities the tone keeps steady.

Steel Workers' Wages.

The ascertainment of prices in the South Wales Siemens steel trade for July, August and September shows 36.25 per cent., as compared with 28.75 per cent. for the previous three months. This will give the steel trade workers an advance of 7½ per cent. in wages as from October 4th, in accordinace with the terms of the sliding scale. The employers, however, are paying a voluntary bonus above base rates, so that the actual effect on the scale is a rise from 3¾ to 11¼ per cent. above base rates.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Contractors' Machinery Company, Limited, has moved from 17, Victoria-street, S.W. 1, to 7, Lower Grosvenor-place, London, S.W. 1. Its new telephone number is Victoria 7751.

Anglo-Overseas Engineers and Merchants, Limited, have removed their offices from Lennox House, Norfolk-street, Strand, to Oswaldestre House, Norfolk-street, Strand, London, W.C. 2. Their telegraphic address remains the same, *i.e.*, "Mechanical, Estrand, London," but their telephone numbers have been changed to Central 3932, 3933.

CONTRACTS.

Joseph Kaye and Sons, Limited, of Lock Works, Leeds, recently received from the Admiralty a contract for their improved force-feed type of serrated steel seamless oilcans.

During the last three weeks Mirrlees Bickerton and Day, Limited, have received orders for nine Diesel engines for installation in different electricity generating stations in Canada, India, Burmah, Malay and New Zealand.

The Staveley Coal and Iron Company, Limited, near Chesterfield, has received from the Chesterfield Corporation an order for a number of cast iron pipes lined with concrete, the manufacture of which was recently added to the activities of the firm.

The tender of J. Blakeborough and Sons, Limited, Brighouse Yorks., for the supply of sluice valves, hydrants and fittings for the ensuing twelve months has been accepted by the Admiralty, and it is interesting to record the fact that the firm mentioned has now held the contract for seventeen successive years.

The Anglo-American Oil Company, Limited, has placed an order with James Pollock, Sons and Co., Limited, of London and Faversham, Kent, for a steel screw coasting tanker of 115 tons deadweight capacity, fitted with a 135 brake horse-power Bolinder heavy oil engine of the latest type with several special features, including electric starting.

Faraday House Old Students' Dinner.—The annual dinner of the Faraday House Old Students' Association was held at the Hotel Cecil on October 19th, 1923, Mr. H. W. Miller, M.I.E.E., the president of the Association, being in the chair. The President announced that an "Old Faradian" had sent a gift of £25 for the Sports Clubs of the College. The toast of "Faraday House" was proposed by Mr. W. W. Lackie, C.B.E. He pointed out that he had met Faradians holding leading positions in all parts of the world. He was interested to notice that the College was affiliated with the city of Winnipeg hydro-electric system, one of the leading cities of the world in municipal ownership. Four Faraday House students were now there, studying the latest developments in high-tension hydro-electric engineering. In reply, Dr. Alexander Russell reported the continued prosperity of Faraday House, and said that the workshops, laboratories, and testing rooms were all being re-equipped with the very latest machines and apparatus. In 1919 the College was affiliated to seventy-one works, corporation undertakings, and electric railways. It is now affiliated to 139, of which eighty-one are manufacturing works. He reported the successes of the old students during the past year. The occasion of the dinner was taken advantage of to present a cabinet of silver and a gold cigarette case to Dr. Alexander Russell, to mark his accession to the presidentship of the Institution of Electrical Engineers. The presentation was made by Mr. H. W. Miller, M.I.E.E., the president of the Association, in a speech in which he recalled Dr. Russell's long association with Faraday House and the esteem and affection in which he was held by Faradians, as witnessed by the fact that 600 of them had subscribed to this presentation. Dr. Russell, in reply, stated that it was very gratifying to see so many fathers and sons among the Faradians present, and that of the original small class with which they started in 1890 two had sons who had gained the highest entrance scholarship at Faraday House.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	19/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 5 0	—
No. 1 Foundry	5 3 9	—
No. 3 Foundry	4 18 9	—
N.E. Coast—		
Hematite Mixed Nos.	4 19 0	4 19 6
No. 1	5 0 0	5 0 6
Cleveland—		
No. 1	5 7 6	5 7 6
Silicious Iron	5 7 6	5 7 6
No. 3 G.M.B.	5 0 0	5 0 0
No. 4 Foundry	4 19 0	4 19 0
No. 4 Forge	4 18 0	4 18 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge*	—	—
„ „ Foundry	4 12 6 to 5 0 0	
(3) Northampton—		
Foundry No. 3	4 10 0	—
„ Forge	4 0 0 to 4 2 6	—
(3) Derbyshire—		
No. 3 Foundry	4 15 0	
Forge	3 8 0 to 4 9 0	
(3) Lincolnshire—		
Basic	4 14 0 to 4 15 0	—
No. 3 Foundry	4 16 0	—
No. 4 Forge	4 14 0	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	5 10 0 (a) / 5 15 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best „	13 0 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 12 6 to 10 15 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ½in. and up	10 0 0	—
Sections	9 15 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 17 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 5 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	12 10 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0†	—
Light „	9 0 0 to 9 10 0†	
Billets	8 0 0 to 11 0 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 10 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0 to 10 0 0	
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 0 0	—
Hoops	12 10 0	—
Soft Wire Rods	11 10 0	—
Midlands—		
Small Rolled Bars	9 10 0 to 9 15 0	
Billets and Sheet-bars	7 15 0 to 8 5 0	
Gas Tube Strip	10 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	19 0 0 to 19 5 0	
Angles	9 10 0	—
Joists	9 10 0	—
Tees	10 10 0	—
Bridge and Tank Plates	10 0 0 to 10 5 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½ to 23/3
Block Tin (cash)	202 5 0
„ (three months)	200 5 0
Copper (cash)	60 5 0
„ (three months)	60 17 6
Spanish Lead (cash)	28 5 0
„ (three months)	27 0 0
Spelter (cash)	33 7 6
„ (three months)	32 5 0
Manchester—	
Copper, Best Selected Ingots	64 0 0
„ Electrolytic	65 0 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	30 0 0
„ Foreign	28 15 0

FERRO ALLOYS.

(All prices now nominal.

	Per Ton.	Per Unit
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£21 0 0	8/-
„ 8 p.c. to 10 p.c. „	£20 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£70 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/3 per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 10 0 scale 6/- per unit	
„ Vanadium	18/- per lb.	
„ Molybdenum	9/- per lb.	
„ Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	11/6 per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	22/6
„ „ Ell	24/-
„ „ Splint	23/9 to 25/9
„ „ Trebles	24/6
„ „ Doubles	24/-
„ „ Singles	23/-
Ayrshire—	
(f.o.b. Ports)—Steam	22/6
„ „ Splint	23/9
„ „ Trebles	24/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	21/9 to 23/6
Screened Navigation	27/6
Trebles	25/9
Doubles	23/3
Singles	21/6
Lothians—	
(f.o.b. Leith)—Best Steam	23/9
Secondary Steam	22/9
Trebles	25/-
Doubles	23/9
Singles	22/3

ENGLAND.

(8) N.W. Coast—	
Steams	34/2
Household	46/8 to 57/6
Coke	43/6
Northumberland—	
Best Steams	24/6 to 25/-
Second Steams	22/6 to 23/-
Steam Smalls	15/- to 16/6
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/- to 25/-
Second	22/6 to 23/6
Household	25/- to 28/-
Foundry Coke	50/- to 52/6

Sheffield	Inland.	
Best Hand-picked Branch	31/6 to 32/6	—
Barnsley Best Silkstone	27/6 to 29/-	—
Derbyshire Best Brights	27/- to 29/-	—
„ „ House	23/- to 24/-	—
„ „ Large Nuts	21/- to 22/6	—
„ „ Small „	15/- to 16/-	—
Yorkshire Hards	21/- to 23/-	—
Derbyshire „	20/- to 22/-	—
Rough Slacks	11/6 to 13/6	—
Nutty „	10/- to 12/-	—
Smalls	7/- to 9/-	—
Blast-furnace Coke (Inland)	32/- to 33/-	
„ (Export)	f.o.b.	37/6 to 38/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/6 to 28/-
Second „	26/- to 27/-
Best Dry Large	27/- to 28/-
Ordinary Dry Large	26/- to 27/-
Best Black Vein Large	26/6 to 27/-
Western Valley „	25/- to 26/-
Best Eastern Valley Large	24/- to 25/-
Ordinary „ „	23/- to 24/-
Best Steam Smalls	18/- to 19/-
Ordinary „	16/- to 18/-
Washed Nuts	27/6 to 30/-
No. 3 Rhondda Large	28/- to 29/-
„ „ Smalls	24/- to 25/-
No. 2 „ Large	23/- to 24/-
„ „ Through	18/6 to 19/6
„ „ Smalls	16/- to 17/-
Coke (export)	42/6 to 50/-
Patent Fuel	29/- to 32/-
Pitwood (ex ship)	28/6 to 29/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	45/- to 47/6
Seconds	35/- to 37/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	57/6 to 60/-
Nuts	57/6 to 60/-
Beans	45/- to 47/6
Peas	27/- to 28/-
Breaker Duff	12/6 to 13/-
Rubbly Culm	14/6 to 15/-
Steam Coals:	
Large	24/- to 25/-
Seconds	22/- to 23/-
Smalls	14/- to 16/-
Cargo Through	19/- to 21/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b

* Quotations extremely high and nominal. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Ruhr Supplies.

It is difficult to get away from the question of the Ruhr supplies of coke and coal, when it completely dominates the situation of the iron and steel trades. A week ago it appeared as if the cessation of the "passive resistance" would put an end to the uncertainty that has long paralysed the industry, and in the belief that the difficulties were being finally overcome there was a sagging of prices, which had the effect of keeping buyers off the market. There is, so far, no sign of the expected acceleration in the consignments of coke, which are still restricted to the very few ovens being worked by the French themselves, and the order issued by the German Government to operatives in the Ruhr to return to work has done nothing towards settling the question of reparations. As the German Government refuses to finance the supplies for reparation unless it can participate in the control of the Ruhr, and as the French Government absolutely refuses to permit of any official German interference, the situation is at a deadlock. The iron and steel trades, therefore, continue perplexed, although a fair amount of business is being done, especially for structural material, of which large quantities are going into consumption.

Franco-British Co-operation.

The possibility of the commercial arrangements to be carried out between Great Britain and the Dominions affecting trade with the Continent is giving rise to many suggestions which show that the French industrial and commercial communities are fully alive to the necessity of doing something to prevent any further restrictions upon trade between the two countries. Unfortunately, so long as there was no fear of any change in the British fiscal policy, official circles here did nothing to show that there was any desire to help British industry, which had been looking forward especially to a participation in the work of reconstruction, and now that events seem to be shaping themselves in the direction of diverting more of the British custom to the Dominions, proposals are made to give to the French policy a more commercial character, while one authority has published a long communication in which he shows that Great Britain and France must co-operate if they would keep some of the world's markets. He refers especially to China, which, he says on the strength of an extended residence in that country, will, he fears, fall under the Soviet influence unless counteracted by a combined and active propaganda. There is now a decided feeling that something must be done to preserve the British market by offering advantages to British firms, although in what way that can be done is not quite clear, unless the co-operation should extend to a participation in the valuable contracts which French firms are securing in Eastern Europe. The granting of further facilities for doing business in this country would probably be rendered illusory, for the time being, by the differences in money values. Still, public opinion is coming round to the suggestion that has been frequently made by commercial associations in favour of the Government declaring a commercial policy which will help to develop foreign exchanges.

Foreign Trade.

So far as the foreign trade is concerned, this country is in a better position than it was even before the war. On account of the fluctuations in money values and of the different methods of valuation employed in the case of imports and exports, it is scarcely possible to make a satisfactory comparison, but as the values of exports during the first nine months of the year approached the import values, despite the considerable increase in the purchases of British coal and coke, it is evident that the French have been developing their exports of manufactured goods. In value, manufactured goods totalled 11,623 million francs, as compared with only 3157 million francs of imports. In taking the weights, however, the imports, amounting to 40,421,390 tons, included 35,239,281 tons of raw material, principally coal, while the exports totalled 17,647,218 tons, of which 14,500,000 tons consisted of partly manufactured iron and steel and raw products generally. Manufactured goods amounted to nearly 2,200,000 tons, or about twice the amount of imports. As compared with a year ago, the only decline has been in the imports of manufactured goods, which have, nevertheless, slightly increased in value.

Continuous Brakes.

The International Conference in Paris has recommended the adoption of the Westinghouse continuous brake by the Berne Conference. It would therefore appear as if a solution were at last arrived at over a question which has aroused a considerable amount of controversy and competition during the past few years. The decision is still dependent upon the results of supplementary tests, which are now being carried out, to see if the Westinghouse brake fulfils certain conditions that had been overlooked in the previous trials; but as that brake now remains alone in the field, and as the French railways are virtually committed to it, there appears to be little doubt that it will receive strong support at Berne. At the same time, since the final trials have not been completed, the International Conference has been obliged to make certain reservations. It is felt in this country that too much time has already been lost and that the negotiations carried out with Czecho-Slovakia and other countries for the adoption of the German and Danish brakes necessitates an urgent decision, and in making a recommendation before it is proved that the Westinghouse fulfils certain requirements, the Conference has had to specify that other systems of continuous brakes can be employed on condition of their being interchangeable with the Westinghouse,

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

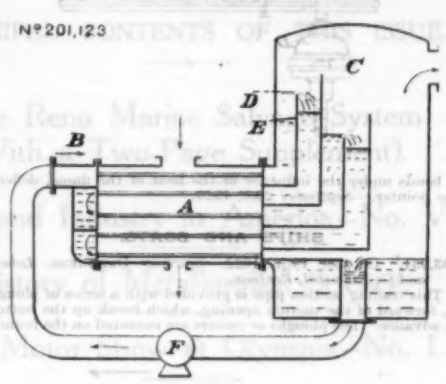
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

201,123. October 24th, 1922.—Evaporators, Société des Condenseurs Delas, 103, Rue Saint Lazare, Paris.

In this evaporator the heating tubes A are heated in any convenient manner, by steam, for instance. The liquid to be evaporated is supplied at B, passes through the upper rows of tubes and rises in the evaporator C to the level D. It flows over

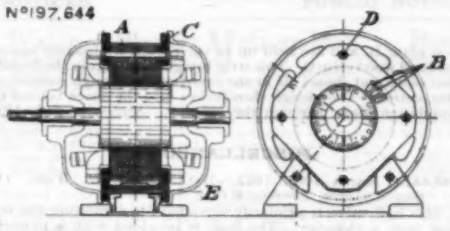


the weir E, evaporating in the process. It returns by the second row of heating tubes and the process is repeated until the liquid arrives at the bottom of the evaporator, from which it is drawn by the pump F for return to B. In this way the whole of the head necessary to keep the liquid in circulation is concentrated in one pump, yet ample free surface for evaporation is provided. —*September 20th*, 1923.

DYNAMOS AND MOTORS.

197,644. February 6th, 1923.—Improvements in the Construction of Stators for Dynamo-electric Machines, Ateliers de Constructions Electriques de Charleroi, Société Anonyme, of 91, Rue de l'Enseignement, Brussels, Belgium.

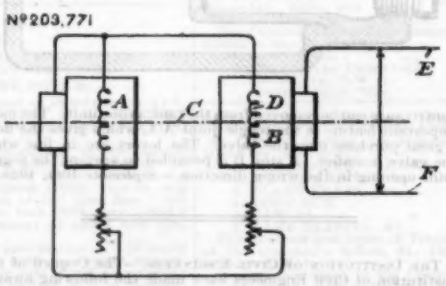
According to this invention, the stator of an induction motor consists of steel laminations A of square shape with the corners



removed, so as to form a polygon. Slots B receive the inductor windings. The clamping discs C and the laminations A are held together by rivets D. The base plate is arranged to fit between the discs C and to some extent around one of the corners of the assembled laminations, and it is secured to the stator by means of dowels E passing into holes formed for this purpose in the clamping discs.—*September 20th*, 1923.

203,771. June 12th, 1922.—Improvements in and relating to Control Mechanism for Electric Motors and Other Apparatus, The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2, and Ralph David Given, of 27, Clarendon-street, Leamington.

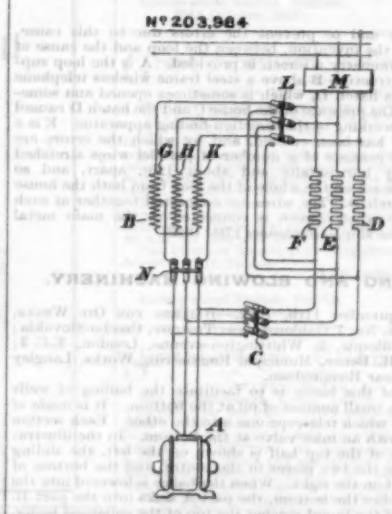
This invention relates more particularly to mechanism for controlling the speed of electric motors. The object is to provide mechanism whereby a very sensitive control will be obtained, large controlling forces being derived from small changes in speed. A and B represent two small direct-current machines mounted on a common shaft C, which is coupled directly or



through gearing to the shaft of the apparatus to be controlled, which is assumed to be a direct-current motor. The machine A is self-exciting and supplies the current for the field winding D of the machine B. The field system of the machine A is practically saturated, so that the machine will be quite stable. The field of the machine B, on the other hand, is not saturated, and the flux will therefore be proportional to the field current, but as it is separately excited, the machine B will also be stable. The armature of the machine B supplies current to the control coil of a Tirrill regulator by way of the leads E F. If the speed of the control apparatus changes to N times the normal speed, then, as the field of the machine A is practically saturated, the voltage at the brush terminals will be N times the normal value, and the field of the machine B will therefore be N times its normal value. Owing to the increase in speed of the machine B, the voltage at its brush terminals will be N^2 times the normal value. Thus a small change in speed produces a large change in the voltage of the machine B, and the Tirrill regulator is affected very quickly as the result of the small change in speed. In actual practice, the field of the machine A will increase slightly with increase of speed, so that the effect on the voltage of the machine B is greater than described above. The Tirrill regulator operates on the field strength of the motor being controlled in a well-known manner.—*September 12th*, 1923.

203,984. February 5th, 1923.—Improvements in and relating to Methods of and Apparatus for Starting Alternating-current Motors, *The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2.*

One of the objects of this invention is to provide a method whereby the potential applied to a motor during starting is increased from the initial low potential determined by the starting tap of the compensator to the full-line potential, without either opening the motor circuit or dropping the applied potential. Another object is to provide an improved method whereby when the motor is directly connected to the line and the compensator is disconnected, it does not take any exciting current from the line. The motor A is adapted to be connected to the three-phase source of supply, and the starting transformer or compensator B is provided for supplying a reduced potential to the motor for starting. The switch C is provided for connecting the resistances D, E and F in shunt to the upper or higher potential sections of the compensator G H K respectively. The switch L is provided for connecting the compensator B to the source of supply in one of its positions, and for short circuiting the resistances D, E and F in the other of its positions, so as to connect the motor finally directly to the source of supply. With the parts in their various positions shown, the method of

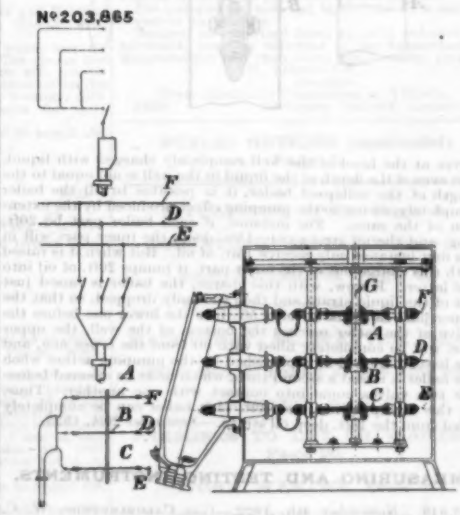


using the gear is as follows:—The circuit breaker M is first closed, thereby connecting the motor to the source of supply through the reduced potential taps of the starting compensator B. When the motor has run up to the proper speed, determined by the potential supplied to the motor through the reduced voltage taps of the starting compensator, the switch C will be closed, thereby connecting the resistances D, E and F in shunt to the sections G H K respectively of the starting compensator B. This provides a direct path from the source of supply, including the resistances D, E and F. The switch N is then opened, disconnecting the motor from the compensator, and the switch L will be thrown to make engagement with its lower set of contacts, and to open the circuit through its upper sets of contacts, thus disconnecting the compensator from the line. If desired, the resistances D, E and F may be adjusted to such a value that the operation of opening switch N will apply an increased potential to the motor before the switch L engages with its lower sets of contacts, thereby short circuiting the resistances D, E and F, and connecting the motor directly to the source of supply. It will be seen that the motor is started without opening up the motor circuit during the starting operations, and without permitting the potential applied to the motor to drop during the starting operations.—*September 20th*, 1923.

SWITCHGEAR.

203,865. August 8th, 1922.—Improvements in Electric Switch Mechanism, Hendrik Arend Hidde Nijland, of Merwedekanaal, Utrecht, Holland.

The switchgear described in this specification is designed to



avoid crossing conductors of different polarity and tension. The usual arrangement is shown in the two upper left-hand views, in which it will be seen that crossings of the conductors are unavoidable; whilst the lower

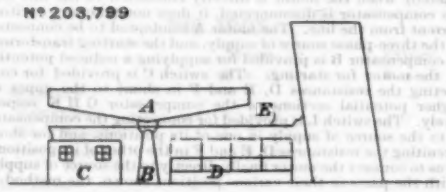
drawings show the improved arrangement. The knife switches A B C in the latter case and the terminals D E F are arranged in line, and crossings are avoided. Another feature of the invention is that all the switch members move on a common axis G.—*September 20th*, 1923.

TELEGRAPHS AND TELEPHONES.

203,799. June 16th, 1922.—Improvements in Wireless Direction-finding Apparatus, Cecil Davis, of 84, Clarence-drive, Hyndland, Glasgow.

It has been found when using a closed loop aerial on board ship for direction-finding purposes that errors are apt to creep in owing to the lack of symmetry in the two parts of the loop, and that this lack of symmetry is caused by the presence of adjoining metal structures or machines. For instance, a steel frame wireless telegraph house or cabin, the hatch of an engine-room which is sometimes open and sometimes closed, a tank on deck, &c., have led to errors because those parts render the loop asymmetrical. The object of this invention is to overcome

N° 203,799



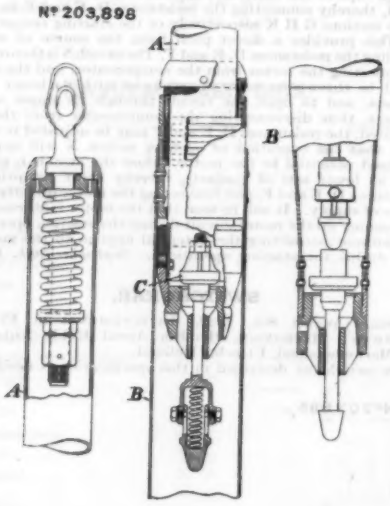
this difficulty and to prevent the errors due to this cause. According to the invention, between the loop and the cause of the lack of symmetry a screen is provided. A is the loop supported on a structure B above a steel frame wireless telephone house C and a hatch D, which is sometimes opened and sometimes shut. The presence of the house C and the hatch D caused errors in the working of the direction-finding apparatus. E is a screen which has been erected, and by which the errors are obviated. It consists of a number of parallel wires stretched approximately horizontally and about 12in. apart, and so arranged as to screen the whole of the loop from both the house C and the hatch D. The wires are connected together at each end, and the whole screen is connected to the main metal structure of the ship.—*September 17th*, 1923.

PUMPING AND BLOWING MACHINERY.

203,898. September 11th, 1922.—Bailers for Oil Wells, J. Streda, No. 7, Gablonstrasse, Trutnov, Czecho-Slovakia; G. J. Gillespie, 2, Whittington-avenue, London, E.C. 3; and E. H. Bence, Municipal Engineering Works, Langley Green, near Birmingham.

The idea of this bailer is to facilitate the bailing of wells having only a small amount of oil at the bottom. It is made of two sections, which telescope one into the other. Each section is provided with an inlet valve at the bottom. In the illustration, the top of the top half is shown on the left, the sliding joint between the two pieces in the centre, and the bottom of the lower half on the right. When the bailer is lowered into the well and reaches the bottom, the part A sinks into the part B. If the level of the liquid reaches the top of the collapsed bailer, the inner part A will at once be filled with liquid, which is retained therein owing to the closing of the valve C when the bailer is raised. At the extension of the bailer when the latter is raised, the lower part will also be filled, and the bailer will

N° 203,898



arrive at the head of the well completely charged with liquid. But even if the depth of the liquid in the well is not equal to the length of the collapsed bailer, it is possible to fill the bailer completely, owing to the pumping effect produced by the extension of the same. For instance, if each bailer part be 20ft. long, and the oil strata only 15ft. deep, the inner part will in the first instance only receive 15ft. of oil. But when it is raised with this charge out of the outer part, it pumps 20ft. of oil into the latter. If now, with this charge, the bailer is raised just out of the liquid strata and then suddenly dropped, so that the upper part can sink at least 5ft. into the lower one before the valve of the latter reaches the bottom of the well, the upper part will be completely filled with oil from the lower one, and the lower part will be replenished by the pumping action when the bailer is raised a second time, which must be effected before the two valves come into contact with one another. Thus, by this manipulation, the 40ft. long bailer can be completely filled from the 15ft. deep oil strata.—*September 20th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

203,949. November 4th, 1922.—Gas Calorimeters, W. C. Peebles, of Peebles and Co., Limited, Tay Works, Bonnington, Edinburgh.

This instrument is intended to be calibrated against a standard calorimeter and then used for everyday approximate testing purposes. It comprises a Bunsen burner A provided with volumetric and pressure governors C and D. Above the flame of the burner there is a strip E built up of two metals having different coefficients of expansion. This strip is connected with the pointer F through the linkage shown, and, as

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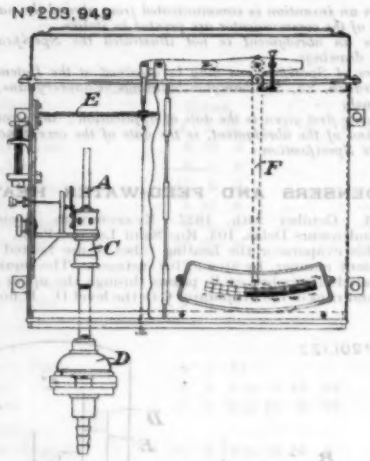


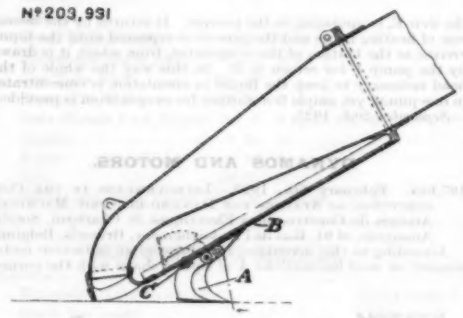
it bends under the influence of the heat of the flame, deflects the pointer.—*September 20th*, 1923.

SHIPS AND BOATS.

203,931. October 19th, 1922.—Suction Dredgers, *Lobnitz and Co., Limited, Renfrew.*

This trailing suction pipe is provided with a series of ploughs A, forward of the suction opening, which break up the bottom in advance. The ploughs or cutters are mounted on the founda-

N° 203,931



tion plate B, and are held up to their work by bearing against the hard wood strip C. This strip bridges openings in the foundation plate and shears off in the event of the plough meeting an obstruction. The plough then retires into the space behind the foundation plate, through the opening.—*September 20th*, 1923.

MISCELLANEOUS.

203,641. March 10th, 1922.—Ball Cocks, *H. Wade*, 111, *Hatton-garden, London, E.C.* 1.

This ball valve is primarily intended for regulating the outflow from a chamber. The float is provided with a powerful leverage, so that it can operate a large valve, and the whole

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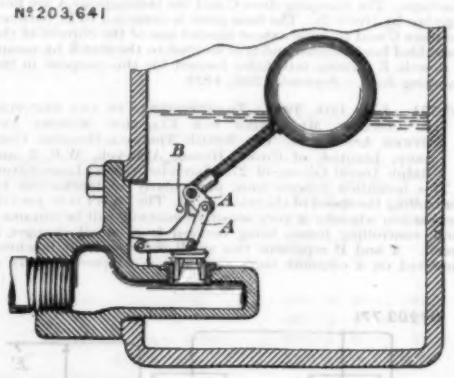

contrivance can be removed from the tank as one unit. The most important feature is the toggle joint A A, which gives the float a great purchase over the valve. The levers are in line when the valve is seated. A stop B is provided to prevent the toggle joint opening in the wrong direction.—*September 10th*, 1923.

The Institution of Civil Engineers.—The Council of the Institution of Civil Engineers have made the following awards in respect of selected engineering papers published without discussion during the session 1922–1923:—A Watt Medal to Mr. T. E. Houghton, M. Eng., Assoc. M. Inst. C.E. (Liverpool); and Telford Premiums to Mr. J. W. Meares, C.I.E., M. Inst. C.E. (Guildford); Mr. J. W. Spiller, M. Inst. C.E. (Maidenhead); and Messrs. G. S. Coleman, D.Sc., Assoc. M. Inst. C.E. (Manchester), and Dempster Smith, M.B.E., M.Sc. Tech. (Manchester), and in respect of papers read before meetings of students of the Institution in London and the provinces during the same period:—Miller Prizes to Mr. E. L. Everatt, Stud. Inst. C.E. (Newcastle); Mr. J. G. Kimber, Stud. Inst. C.E. (London); Mr. A. H. Naylor, M.Sc., Stud. Inst. C.E. (London); Mr. E. Sykes (Birmingham); and Mr. F. J. Symonds, Stud. Inst. C.E. (London).

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Civil Engineers: Yorkshire Association.—Philosophical Hall, Leeds. Presidential address by Mr. H. E. Yerbury. 7.30 p.m.

Institution of Municipal and County Engineers.—Town Hall, Chatham. South-Eastern District meeting. 10.30 a.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Crystals for Wireless Reception," by Mr. A. V. Ballhatchet. 7.30 p.m.

Manchester Association of Engineers.—Memorial Hall, Albert-square, Manchester. Paper, "Aeroplane Design," by Mr. Roy Chadwick. 7 p.m.

Manchester Association of Engineers.—Visit to works of Crossley Motors, Limited, Gorton-lane, and A. V. Roe and Co., Limited, Briscoe-lane, Newton Heath, Manchester. Start from Albert-square at 2 p.m.

Newcomen Society.—Prince Henry's Room, 17, Fleet-street, E.C. 4. Presidential address, "The Value of the History of Technology," by Mr. L. St. L. Pendred. 5.30 p.m.

SATURDAY, OCTOBER 27TH.

Institute of British Foundrymen: Lancashire Branch.—Mining and Technical College, Wigan. Lecture, "The Manufacture and Characteristics of Cast Iron," by Mr. S. G. Smith. 7 p.m.

Institution of Municipal and County Engineers.—Council Chamber, Town Hall, Torquay. South-Western District meeting. 2 p.m.

TUESDAY, OCTOBER 30TH.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Discussion on paper, "Losses in the Component Parts of a Three-stage Turbine Pump," by Dr. W. Blackadder. Paper, "Auxiliary Machinery for Diesel-engined Vessels," by Mr. R. Love. 7.30 p.m.

University of Birmingham Metallurgical Society, Edgbaston, Birmingham.—"The Work and Position of the Metallurgical Chemist," by Sir Robert Hadfield. 5.30 p.m.

WEDNESDAY, OCTOBER 31ST.

Institution of Production Engineers.—The Engineers' Club, Coventry-street, W. 1. Paper, "Idle Capital in the Machine Shop," by Mr. A. Easthope. 7.30 p.m.

THURSDAY, NOVEMBER 1ST.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. "Industrial Research, with Special Reference to Electrical Engineering Development," by Mr. W. Wilson. 6 p.m.

Women's Engineering Society.—Hotel Cecil, Strand W.C. 2. Ball. 9 p.m.

FRIDAY, NOVEMBER 2ND.

Institution of Mechanical Engineers.—Storey's-gate, S.W. 1. Thomas Hawksley Lecture, "The Mechanical Problems of the Safety of Life at Sea," by Sir Westcott S. Abell. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Hydraulic Propulsion," by Mr. D. V. Hotchkiss. 7.30 p.m.

FRIDAY TO SATURDAY, NOVEMBER 2ND TO 10TH.

Commercial Motor Exhibition at Olympia.

SATURDAY, NOVEMBER 3RD.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Sackville-street, Manchester. Paper, "Test Bars: Making and Testing Them," by Mr. J. L. Glen Primrose. 4 p.m.

MONDAY, NOVEMBER 5TH.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Fourth annual general meeting. Paper, "A Transport Anventure in Persia," by Mr. T. Salkield. 5.30 p.m.

THURSDAY, NOVEMBER 8TH.

Institute of Metals, Royal School of Mines, South Kensington, S.W. 7.—Lecture: "Some Impressions of American Non-Ferrous Metallurgy," by Dr. W. Rosenhain.

SATURDAY, NOVEMBER 10TH.

Finsbury Old Students' Association.—The Engineers' Club, Coventry-street, London, W. 1. Twelfth annual dinner. 7 p.m.

TUESDAY, NOVEMBER 20TH.

Institute of British Foundrymen: Lancashire Branch. Burnley Section.—Municipal College, Ormerod-road, Burnley. Paper, "The Founding of Admiralty Gun-metal and Allied Alloys," by Mr. F. W. Rowe. 7.15 p.m.

THURSDAY TO THURSDAY, NOVEMBER 22ND TO 29TH.

Public Works, Roads and Transport Exhibition.—At the Royal Agricultural Hall, Islington, N. 1.

R 38 Memorial Prize.—From the income of the above Fund a sum of twenty-five guineas will be offered as a prize for the best paper received by the Royal Aeronautical Society on some subject of a technical nature in the science of aeronautics. Other things being equal, preference will be given to papers which relate to airships. The prize is open to international competition. The Royal Aeronautical Society retains the right to withhold the prize in any year if it is considered that no paper is of sufficient merit to justify an award. Intending competitors should send their names to the Secretary of the Royal Aeronautical Society, 7, Albemarle-street, London, W. 1, on or before December 31st, 1923.